MACHINERY.

VOL. 2. September, 1895. NO. 1.

LOOKING BACKWARD AND FORWARD.

JOHN J. GRANT.

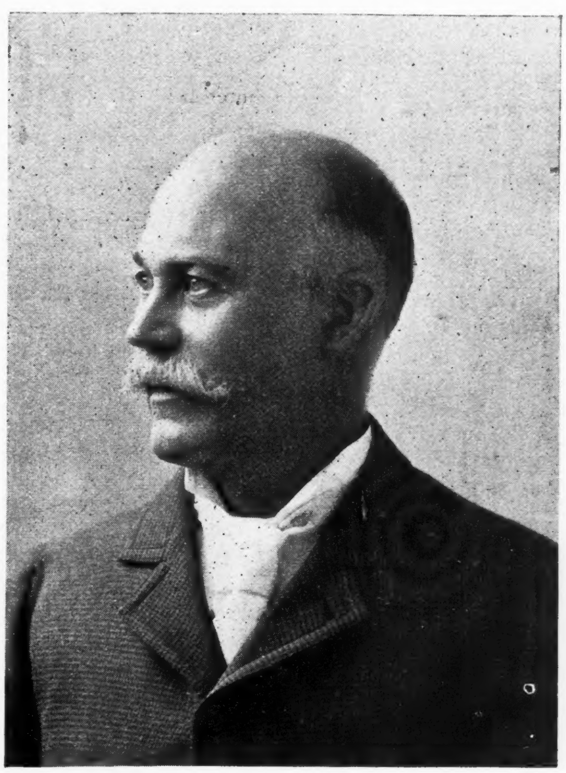
FORTY years ago does not seem so far away, but during that time what a change has been made in the equipment of the machine shop and machine manufactories. Previous to that date many of the lathes in use were of the chain-feed pattern, and often with wooden bed or sill, with cast iron track screwed on. The spindles in a 16-inch engine lathe were seldom of a greater diameter than 1½ inch and with a front bearing box of but little greater length. About that time the splined rod and friction feed came into use and better designed and heavier tools with it.

Chains had not been entirely superseded by the rack, in planer construction, and in fact many small shops had not at that time aspired to the dignity of owning a planer. The architectural designs which included panelled beds, lion's claw legs and fluted columns were beginning to lose their attractions to mechanics, although I often heard the old-timers of that date bemoan the degenerated ideas of the new draftsmen. If some of them were alive and in the harness to-day, I wonder what they would think of the modern tool with graceful lines and without the least attempt at embellishment either as to useless finish, O. G.'s, or corners which are simply dirt catchers. In upright drilling machines none were of the quick return type, and few of them had power feed; the design in most cases was very faulty, having only one post or column, and that of small diameter compared with the diameter of the hole it was designed to drill.

There was no such tool as the universal milling machine, the nearest approach to it being the Lincoln index milling machine. The common milling machine, or as it was called at that time, the slabbing machine, was only used in manufactories where large quantities of regular work were turned out. Thirty-seven years ago last March I went to Brown & Sharpe's shop to learn my trade. At that time the works were *hardly* as large as at present, occupying an old dwelling house at 115 South Main street, Providence. If my memory serves me right, I had the honor thrust on me of manipulating the first milling machine ever used in the shop, this wonderful machine having been altered over from an old hand planer, and the first job done on it was facing the hook guards for the Wilcox & Gibbs sewing machine.

There were very few turret lathes in use, and none of them with the self-revolving head. Again, I have the honor of having made the first of this style, while at the works of the Florence Sewing Machine Co., at Florence, Mass.

The change in the system and cost of producing articles manufactured in quantities, by the use of these two machines, is beyond calculation.



John J. Grant.

I have mentioned only the more prominent tools used in the machine shop, as it would require a mechanical dictionary to name all the various small machines with their ingenious attachments and small tools and gauges for the quick and accurate production of work that have been designed and come into general use in the past few years. Looking back it would seem at that time to have been almost impossible to have produced good and accurate work; but, as the boys say, "We got there, Eli," and I have seen many small tools, jigs and fixtures which lose nothing by comparison with their duplicates made at the present time. Much has been said about modern machines and tools of precision having a tendency to degenerate the quality of the workman and to eventually destroy the individuality of the all-around mechanic. I do not believe this. The skill required to operate the modern tool is just as great as those made fifty years ago, and there is actually more call to-day for the good general machinist than at any previous time. This is not due to their scarcity, as I believe there was never, proportionately, so many good mechanics as at the present day.

When we see what has been done in the matter of improving machine tools in the past forty years, what may we expect in the *next* forty? I am a most thorough believer in endless progression, and can see in my mind's eye the future machine tools. Should I put my whole ideas on this matter in print, I should be called a bigger crank than I was when writing articles on the milling machine, which was only about eight years ago, and O, ye skeptics, what a change the past few years have made, not only in the development of the milling machine itself, but in the quantity (without lowering the quality) of the work produced. We will not go too far, but let us prognosticate a little and we will imagine ourself in, say, the large engine or electrical machine works of 1920. The first thing we notice is the odd looking lathes. We of course know what they are, because the transition that has taken place is not so great that the identity of the lathe is entirely obliterated; but what a change from the—what shall I call it?—well, say the jobbing lathe of to-day. Here we see the tool stripped of all its gimcracks and designed to accomplish, with the least possible cost, just one class of turning; this may be, for instance, plain turning of shafts, spindles and like work. In this case the lathe would be made with a bed of entirely different shape; the head and foot stocks would be made very low, perhaps not more than two inches above the top of carriage, which would itself be of an entirely different design. The lighter lathes would be driven by a pulley direct, no change of speed by cone pulley, and in the heavier lathes for the same class of work, by a simple half-back gear.

The feeding mechanism for the carriage will be very strong and of simple design, to allow of heavy cuts, as the tendency of the times is to work stock from the bar more than from forgings, owing to the cheapness of Bessemer and open hearth steel. The above ideal lathe will cost less than one half of those in use at the present time and will produce twice the quantity of work.

As we pass through these works of the future we shall see tools which we shall be tempted to ask for what purpose they were made, but we will presently see the traveling crane come along and drop a heavy casting on the large revolving table, which is flush with the floor and has two large uprights similar to the present vertical boring mill; these can be moved in various positions by the movement of a lever; they have heavy spindles that will carry milling and facing tools, as well as lighter auxiliary spindles for drilling, boring and tapping. This will be the large planer of the future. The small planer will be superseded by the milling machine.

In many of the larger works there will be in the proper place in the shop two uprights, one at each side of the shop; attached to these uprights will be a cross-rail reaching entirely across the room; this rail will be adjustable in height, and will carry several drill-spindles. Planed track will be laid dead level under this rail and at right angles to it; cars or traverse tables in which the wheels can be locked, and having an iron table which can be surfaced off by a cutter in one of the spindles. This will be the radial drill of the 1920 works. In all the various machines we shall see the same radical changes, and the tendency will be towards more accurate machining of parts so that they may be more quickly assembled. In many shops the line shafting will be entirely done away with, and either short countershafts driven by motors, or we may see by that time machines driven by a motor connected to the machine or its countershaft. I will stop here and simply say that the changes we shall see in the machinery used to manufacture machinery will undergo a greater change in the next twenty-five years than it has in the past forty.

* * *

SHOP WORK.

W. D. Forbes.

The readers of Machinery are, generally speaking, either those who buy machines or those who use them, and the maker, who is a buyer and user, knows how serious an error it is that their interests are so rarely considered mutual.

The question to an intelligent buyer is, Will the new lathe, planer, miller, or other tool, do more and better work than those already in the shop? One class of man who handles tools would answer, "The old chain feed lathe I served my time on will do as much work as any new lathe that can be found." A second class will say, "The tools in the shop do too much work already." A third class will say, "New and better designed tools should do more work, but it is hard to believe that tool steel will stand more than is now given it to do."

We will throw aside the second, we will not say man, but animal; he is a trouble breeder for himself and all who come in contact with him.

The first man is correct under some circumstances, as in this instance, which respresents many. The writer knew a man who was running an old flat-way chain-feeder lathe, turning up pulleys; they were about 10 inches diameter, 2 inch face and 1 inch hole; hubs were not faced. Fifteen pulleys in ten hours was the number turned out.

The man was a thorough machinist and had ripened by years of work at his trade. He had rigged a power feed to the tail-stock and fitted a tool to it. He chucked the pulley by the inside of the rim, having made a special set of jaws for the chuck, which allowed him to round up the inside edge of the rim without turning it around. He turned the face and edges first instead of boring the hub, as is the usual custom; then he put on a high speed and started his tail-stock, and at the same time filed and polished the face. While a cut was being taken on another casting he reamed the hole of the previously finished pulley by hand.

Under the same roof was a much better lathe designed especially for rapid pulley work, but no more pulleys were turned out from it nor were they any better. This was the cause of much talk among the men and considerable thought on the part of the proprietor, and they both came to the conclusion that beyond the fact that the new lathe was better looking it had nothing in its favor, and after all the last thirty years had not shown much progress, at least in the lathe line.

They were wrong, of course. In the first place it is clear that pulleys of the above sizes and made in such quantities would be cast from iron patterns and have very little stock to remove, and anything in the shape of a lathe would do it up to the capacity of the cutting tool. Second, the old lathe was really turned into a special pulley lathe; and third, the most important of all, the man who ran it had far more brains than the one who ran the new tool. If the men had been changed about, the old machine would have been sent to the scrap heap and never rigged up for the work. It was a case of a poor tool and a good man and a good tool and a poor man. Brains told.

It is a very common idea that automatic machines require no brains to run them. The writer has yet to see this proved correct; the brains will be found somewhere, and they are generally in the head of the man to whom the operator turns when sizes get astray or tools break down. Many a proprietor fools himself into the belief that screw machine work is paying, and its cost is the wages paid to the operator plus stock, because the brainy man does not put in his time on the work.

The man who does not see how tool steel can stand any more than he gives it to do is generally a good man, but whose idea of speeds and feeds is not good. It is hard to get him to see that a slower speed often admits of a coarser feed; but when he does catch the idea he turns out work which counts.

A table of speeds is a good thing to have when it can be referred to, but so many conditions are to be met with in machine work that it cannot be relied upon.

The writer had some pinions and gears to turn up and cut. The gears had 1 inch holes, but the arms were so light that the stock had to be nibbled off, while the pinions had 2½ inch holes and the stock could be raked off them at a rate far above recognized feeds or speeds. In milling the teeth the pinions allowed a tooth to be cut in less than ten seconds, while the gears required about a minute.

With close inspection of the many so-called improved tools, the writer sees much to be admired, but he believes that far greater improvements are possible and would not recommend a prospective purchaser to buy any "back number" tools, yet he strongly recommends that before any new tools are bought, those already in use be made to do all they can, either by a better selection of work or a change of man.

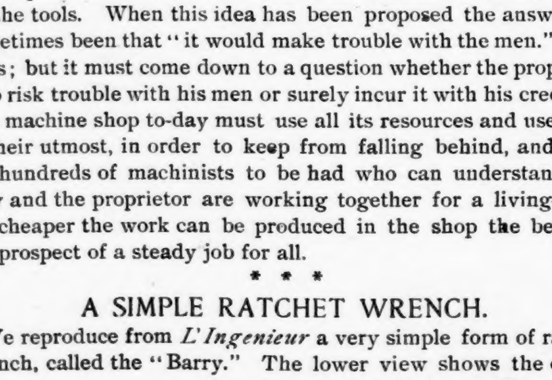
It has been the writer's wish never to have his men work hard, if it is possible to avoid it; but he wants all the hard work done by the tools. When this idea has been proposed the answer has sometimes been that "it would make trouble with the men." Perhaps; but it must come down to a question whether the proprietor is to risk trouble with his men or surely incur it with his creditors.

A machine shop to-day must use all its resources and use them to their utmost, in order to keep from falling behind, and there are hundreds of machinists to be had who can understand that they and the proprietor are working together for a living—that the cheaper the work can be produced in the shop the better is the prospect of a steady job for all.

* * *

A SIMPLE RATCHET WRENCH.

We reproduce from *L'Ingenieur* a very simple form of ratchet wrench, called the "Barry." The lower view shows the operation, the cam A swinging on B as a center engages the body of drill C as shown, the grip tightening as the pressure on handle increases. To reverse the motion it is necessary to take out bolt B and reverse the plates D D and handle con-



taining the cam, not a very convenient method to be sure, but as the majority of work will be in one direction only, it does not entirely prevent its being a useful tool. The shearing strain on the bolt B must be very severe on heavy work.

DRAWINGS FOR THE SHOP.

PROF. C. H. BENJAMIN.

So much has been written on this subject that it may seem superflous to add anything, but a careful scrutiny of "drawings as they are made" will convince any unprejudiced person that there is much room for improvement.

It has been my good fortune, during my connection with the drawing offices and shops of a technical school, to supervise the construction of patterns and machine details made by special permission from the working drawings of some of the leading firms of machinery builders in this country.

In general these drawings evince a clear appreciation of what is needed by the workman, but in some cases the difficulty of interpreting them is much greater than it should be. There is no better school for a machine draftsman than to be compelled to work from his own drawings; then will he realize the meaning of the old saying "put yourself in his place."

If every draftsman were as familiar as he should be with the processes of the shop and with just what the workman needs to know in order to make a pattern or finish a machine detail, there would be much less reason for finding fault with working drawings.

SIZES OF SHEETS.

It is very desirable on the score of economy and convenience that as few sizes of sheet should be used as possible, and that all the drawings actually used in the shop should be of one size, a size not too large for convenience in handling nor yet too small for clearness in the drawing itself Each shop must be a law unto itself in this matter; in my own practice after several changes for one reason and another, I have finally settled on the following sizes of trimmed sheets as the most economical:

For regular shop drawings, 14 x 18 in. which I call size B.

For screw lists, tables and other miscellaneous data, 9 x 14 inches, called size C.

For assembled drawings of machines, 18x28 inches, called size A.

The dimension 18 inches insures economy in cutting blue print or other paper which comes in rolls a yard wide.

The sizes A and B enable one to use sheets of American Bond 19x30 inches or Whatman's Imperial 22x30 inches in either whole sheets or half sheets, and have a margin for sticking down.

I prefer myself to use good bond paper, making the drawing directly on the paper and printing from that.

MARGINS AND TITLES.

It is best to have uniformity in this as in all other features of the drawing. Suppose that a margin of ¾ inches is left all around the sheet, the border consisting of one heavy line.

Let the title be in the lower right corner of the drawing occupying a space, we will say, of 2½x3½ inches next the border. Two small circles just inside the right lower and left upper corners of the border may contain the distinguishing symbol letters or figures of the machine. (I think this last device originated with the Brown & Sharpe Manufacturing Co.)

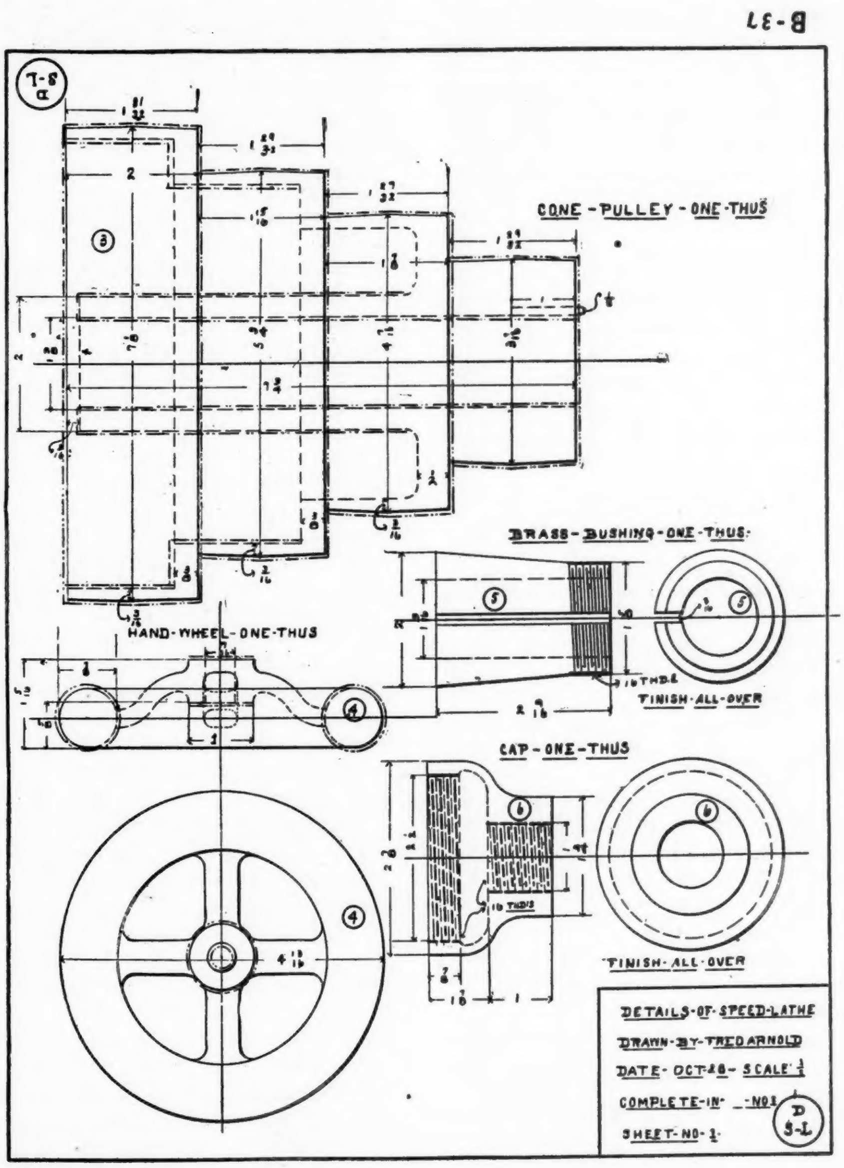
At the other two corners of the sheet just outside the border are put the size letter and the serial number of the sheet, *i. e.*, B-24, means that this is the twenty-fourth sheet of size B, which has been made in that office, and is the symbol by which the drawing is filed and indexed.

The location of symbols at opposite corners enables one to readily find the drawing, even though it may have inadvertently been put in the drawer with the top where the bottom should be.

The best sytem for indexing such drawings would furnish subject matter for another article.

DESIGN DRAWINGS.

The process of designing a new machine involves the construction of drawings which are in no sense working drawings since they are not intended for shop use; they are only tentative, experimental productions, and form an exception to all general rules.



B-37

I think such drawings should be full size if possible and made on a vertical drawing board, much as an artist paints his picture on an easel, so that the general relations of parts and the *tout ensemble* may be readily comprehended, and that what has been called the "critical instinct" may have full play.

In a visit to the establishment of Warner & Swasey, the well-known telescope makers, I noticed not long since a large blackboard suspended in their drawing room with a sliding square attached and learned that much of their designing was done on that to full size and afterwards transferred to paper on a reduced scale.

It seems to be impossible for one to judge of the proper sizes of parts or of their relations to each other and the convenience of the whole, as well from a small drawing in a horizontal position as from full-sized designs.

I have heard of a man who was obliged to draw the plans of his house full size on a convenient snowfield and have his wife walk through the various rooms in order that she might understand the arrangement; the same principle applies to design drawings.

ASSEMBLED DRAWINGS.

After the design has been completed, the experimental machine built and tested, and all the alterations made that are deemed necessary, the time comes for shop working drawings.

I have mentioned the assembled drawing first, but from the nature of the case, these and drawings of the details are carried along together, each modifying the other as the work progresses.

When completed the assembled drawings should show several views of the complete machine, if possible, or at least views of the

main subdivisions of the machine with all the pieces in position. Let every piece or detail be shown clearly in at least one view and numbered on the drawing with its symbol number.

Since Oberlin Smith published his paper on "Nomenclature of Machine Details" (*American Machinist*, Sept. 10, 1881), there is little left to be said on the subject of symbols for machines and machine details, and any one seeking information cannot do better than to consult that authority.

The assembled drawing should also contain or be accompanied by a list of the parts in the order of their symbol numbers, giving the name of each, the number used in one machine and the number of the detail sheet on which each may be found. This drawing thus furnishes a comprehensive index of the machine for use in the office or in the setting-up room.

DETAIL DRAWINGS.

It has been my experience that the only safe rule in detail drawings is to draw separately every piece which is made separately, showing only as many views of it as are necessary to a comprehension of its shape and to the placing of dimensions.

I would try to group on one sheet only such pieces as are subjected to the same operations in finishing. For instance, I would put in separate groups planed castings, turned castings, forgings, turned steel work, flat steel work and screw machine work.

Some definite rule should be adopted as to the relative location of the different views of a piece. My own practice has always been to put the front view in the center, a top view above or a bottom view below, a right view at the right or a left view at the left side.

The practical advantage of this method, which is equivalent to using the fourth angle in descriptive geometry, is the fact that the distance between corresponding points on two projections is much less than by the method taught in the schools.

The different views of one detail should be grouped at a sufficient distance from other groups to mark them as belonging together. The symbol number should be on or near each piece and is better enclosed in a circle to distinguish it from dimension figures.

SUB TITLES.

There should also be uniformity as to the location of written information near the various details. The full name of the piece ought to be given, the material of which it is to be made, the number used on each machine, and frequently special directions as to finish. I would recommend grouping all these in one or two lines immediately under the principal view.

The type known to printers as full faced Gothic is more legible than any other and corresponds better to the general character of the drawing.

INKING.

It is very necessary that the ink should be black and opaque, and that the lines should be made of a considerable width; from $\frac{1}{80}$ to $\frac{1}{40}$ of an inch in breadth will insure a good print.

For center lines red ink will answer admirably, as it gives in the blue print a faint line easily distinguished from the other lines of the drawing.

One of the most serious problems in the construction of shop drawings is to invent some method of indicating additions for finish which shall be clear to the workman, not readily overlooked and not liable to be confused with other lines of the drawing.

I have experimented some with the letter *f*, having the intersection of the cross located directly on the line to be finished, but unless very carefully made the letter is often overlooked or mistaken for something else. At present the better plan seems to be drawing a distinctive line on the tracing in black ink, as for instance, a line made up of alternate dots and dashes, to indicate additions for finish, and then to have an experienced hand go over the blue prints and strengthen the finish lines with chemical red ink, so that they may be conspicuous.

FIGURING DIMENSIONS.

The real life and soul of a shop drawing are in the dimension figures; they are to the lines what the breath is to the body. If they are wrong everything is wrong, and if they are confusing or misleading the drawing is worse than useless.

In the first place the figures must be plain and unmistakable. I would recommend a full faced Gothic similar to the lettering, no figures to be less than $\frac{1}{8}$ of an inch in height. Fractions are particularly liable to mislead, and great pains should be taken with them, especially to make the dividing line horizontal and of good size.

For dimensions or 24 inches and under write simply thus: $14\frac{1}{2}$, 18. etc.; and above that write thus: 2 ft. $3\frac{1}{2}$, 4 ft. $2\frac{3}{4}$, etc.

The ′ and ″ marks for feet and inches should not be allowed, since they are so liable to be mistaken for figures, and the same may be said of the ° mark for degrees, which should therefore be written thus: 75 deg., $24\frac{1}{2}$ deg., etc.

It is better to figure only finished dimensions, so that the machinist may know just what is to be exact and what is to be left rough

If the drawings are to be used for patterns, scaling from the drawings will be sufficiently accurate for the unfinished dimensions. In building large machinery separate drawings and templates should be made on a large scale, for the use of the pattern maker, and the same can be done for the blacksmith shop if necessary.

No matter how many views are shown, each dimension should be given but once, and as many of the dimensions should be put on the front view as possible. All the dimensions must read in the direction of the line on which they are located, and so that they can be read either from the bottom on the right end of the sheet; that is, it should never be necessary to rotate the sheet more than 90 deg. to read any dimension.

I would put as many dimensions as possible in one line, and in addition to this give the measurement over all, so that no labor of adding figures may devolve upon the workman. It should be the constant aim to so arrange the figures that one may scan them readily with the least wandering of the eye and the least movement of the sheet.

It is wrong to attempt to crowd figures into a limited space; they can be put at a convenient distance and connected to the dimensions points by a wavy line.

Figures should always be so located that they can be erased or changed without marring a line of the drawing.

One should not hesitate to use good plain English on his drawing to explain what he intends when other means fail him.

A working drawing is but the expression of an idea which in most cases is more readily conveyed by lines and figures than by words; but when lines and figures fail, words are just as legitimate a means to an end.

And finally, the one thing needful is clearness of expression; if the idea of the designer is so expressed that "the *tool-bearing* man, though a fool, may not err," then the drawing is a success; if it does not express the idea clearly it is a failure, no matter what the system used or what the artistic merit of the execution.

* * *

HOW MANY BRICKS IN THIS CHIMNEY?

Robert Grimshaw.

It is desired to build a chimney in the shape of the frustrum of a cone and having a tapering flue. The outside diameter is to be 6 feet at the bottom and 3 feet at the top; the inside diameters 20 inches and 18 inches respectively. The height is to be 50 feet. At the rate of twenty-five bricks to the cubic foot when laid up, how many bricks will there be in the chimney when built? and ordering 15 per cent. more bricks than the volume of the chimney would call for, to allow for waste, how many bricks should be ordered?

Also, what would be the quantities for a 60 foot chimney?

Answer.—We have to calculate the volume of each of two concentric frustums of a cone, and take the difference between them.

The rule for such a conical frustum is to add together the squares of the two diameters and the product of the two diameters, to multiply the sum by $\frac{1}{3}$ the perpendicular height, and to multiply the product by 0.7854.

Taking the quantities in feet we have for the outer frustum $(36+9+18)\times(50\div3)\times0.7854=63\times16\frac{2}{3}\times0.7854=1050\times0.7854=$ 824.67 cubic feet in the outer frustum.

For the inner one or flue we have $(1\frac{1}{2}\times1\frac{1}{2})+(1\frac{1}{2}\times1\frac{2}{3})+(1\frac{2}{3}\times1\frac{2}{3})=2.25+2.5+2.778=7.528$; $7.528\times16.667=125.47$; $125.47\times0.7854=98.56$ cubic feet.

The difference between these two volumes 824.67 and 98.56 is 726.11 cubic feet, and at twenty-five bricks to the cubic foot there would be 18,153 bricks in the chimney.

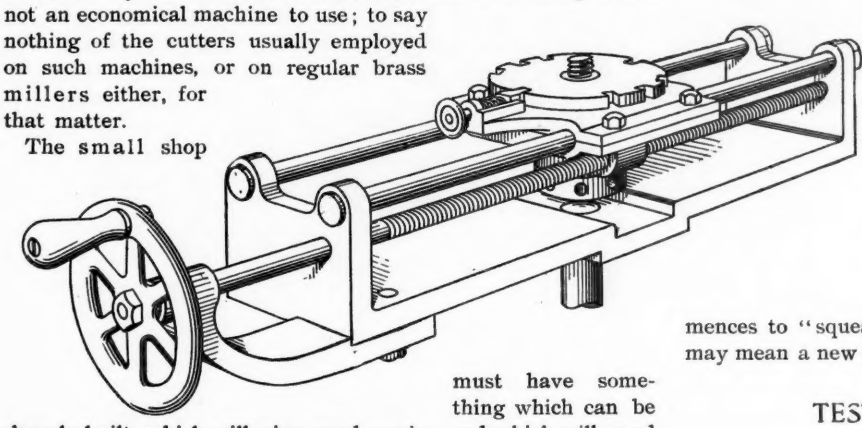
For a 60 foot chimney we would have for the outside frustum $63\times20\times0.7854=989.60$ cubic feet; for the inner one, $7.528\times20\times0.7854=118.25$ cubic feet; their difference being 871.35 cubic feet, which, at the rate of twenty-five bricks per cubic foot, would call for 21,784 bricks.

A CHEAP MILLING MACHINE.

Buffing the sides of square, hexagon or octagon nuts is so unsatisfactory for a large class of brass work that a milling machine is in order even for a small shop, and yet the cost of a special miller for brass work is prohibitive in this sized shop, as it would stand idle three-fourths, or more, of the time.

A regular universal milling machine is often used because it can be used for much other work, but they are also expensive, and unless fitted wtth a high-speed device of some kind, like that illustrated by Mr. Willis in the December issue for example, it is not an economical machine to use; to say nothing of the cutters usually employed on such machines, or on regular brass millers either, for that matter.

The small shop



must have something which can be cheaply built, which will give good service, and which will need few repairs. The machine illustrated with this was designed on the same lines as one which has seen ten years of service and is doing good work to-day, the details of construction, have however been changed, and I think, somewhat improved. As will be seen, this is an attachment for a speed lathe, the bottom of the main casting or frame being planed to fit between the shears of the lathe and secured to it by a strap under lathe bed, on bolt B, and being moved to any position by slackening nut and tapping the frame with a soft hammer. No sizes are given, but the relative proportion of parts is about as in the machine used, the extreme travel of table being about 9 inches. The frame needs little explanation, being a rectangular section of the size necessary for the work in hand—one inch thick by six or seven inches wide being ample for any work up to hex nuts 3½ to 4 inches across the "flats." Rods are used instead of planed ways as they can be turned in any shop having a lathe, while a planer is not always found in small brass shops.

This also permits a ready means of keeping the moving table adjusted by the screws shown, as closing the slots outside of each rod is an easy matter.

Any tool-maker can make one of these without difficulty and get the rods practically parallel with a little patience, although for commercial manufacture, accurate jigs would be needed.

The screw should be of fair size and a moderately quick thread, about 4 to the inch and square or bastard can be used as preferred, or the new 29 degree "Acme" if it is adopted, as seems desirable. Although the cut shows the thread tapped through the body of the moving table, it is better to have a separate brass nut, screwed or bolted on, which can be readily renewed when worn. The rods forming the ways have turned heads and should have a pin or feather to prevent turning, being held in place by nuts at the back side; and it might be well to have the head end a taper fit to draw into a good central bearing, while the nut can also fit into a conical recess if desired. For ordinary purposes good fits in straight, round holes will answer every purpose. The index is cut around the edge of the milling plate or table and can be divided as work requires; square and hexagon will be all that are usually needed. The operation of this is similiar to any miller of this class, the milling table T, having a sleeve I, which fits inside of and extends through the body of sliding table D, until it comes a little more than flush with it. The spindle A, fits inside the revolving table and turns with it, the key K, allowing vertical motion, but preventing turning when screwing on chuck C. This is simply a brass ring, threaded inside and out, the former fitting the thread on upper end of spindle, and the latter the work W, in this case a hex nut shown in section. The chuck is screwed up against he shoulder of the spindle by a pin wrench or "side spanner" on the top, and the work W screwed on the chuck until it raises the chuck from the table, and brings edge of the nut a little below the chuck, insuring a bearing for the nut and *not* for the chuck. Tightening the lower nut N with a pin-wrench *against the end of sleeve* I, the upper table should revolve freely and still not have any lost motion. This is regulated by the amount the sleeve projects through body D, which can best be ascertained by a few trials, probably not more than .005 of an inch is necessary to give freedom of motion.

The dotted threads in the upper end of spindle indicate another spindle having a female thread as shown, which will be found necessary on some work. With these two spindles, and chucks for the work in hand the machine is capable of a wide range.

This explains the construction of the machine and the working of the parts, the next step is to show its application to such work as ordinarily comes up in brass shops.

For ordinary work it will suffice to have the milling table about 2½ to 3 inches below center of lathe, the greater this distance, the larger cutter you can use, which within limits is advantageous; this will be spoken of further under "cutters."

* * *

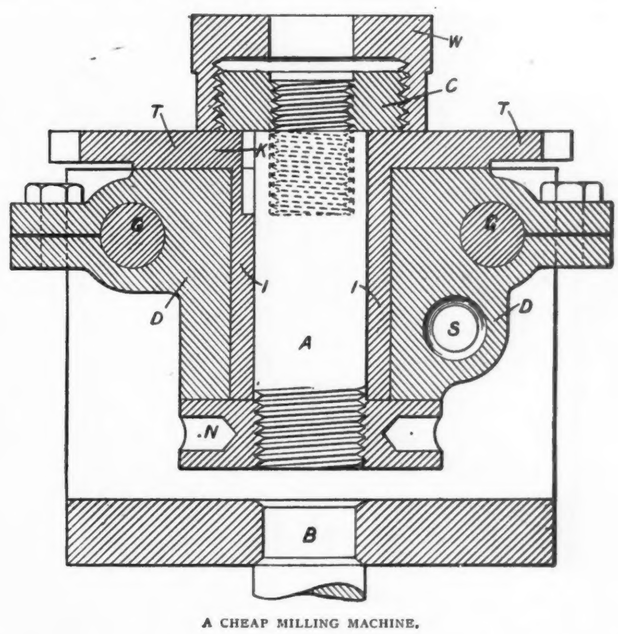
Don't wait till the counter shaft commences to "squeal" before giving it a little oil. A little delay may mean a new counter.

* * *

TEST OF A PUMPING ENGINE.

W. A. Wakeman.

The following report of a test, or rather two tests, of a pumping engine made by a friend and published with his consent, will be of interest to engineers and others, as it was conducted for the purpose of comparing the efficiency of an engine with different points of cut-off. We are well aware that all of the data necessary to enable us to calculate the exact duty of the engine is not given, for it was not intended as a test of that kind, but on the contrary the engineer who made it simply wanted to know how much longer a given amount of coal would last him under one of the two conditions named, than under the other, in order that he might adopt the best plan for his every-day practice, and so serve the interests of his employers. A brief description of the plant will be necessary to an intelligent consideration of the matter.



A CHEAP MILLING MACHINE.

There were two boilers in use, of the ordinary tubular type, the shells being 48 inches in diameter and 15 feet long, each one containing thirty-one 4-inch tubes. The grates are 4 by 6 feet so that each contains 24 square feet. The engine is similar in every respect to a factory engine, except that there is a balance wheel instead of the ordinary fly-wheel, and gears are used to transmit power to the pumps, instead of the belt usually found in the factory. The diameter of its cylinder is 26 inches and the stroke is 4 feet. The speed is controlled by a Judson throttling governor, while the point of cut-off may be varied at will by means of a cut-off valve riding on the back of the main valve, the position of which is varied by a hand-wheel outside of the steam chest.

From the above it will be seen that here is an excellent opportunity to make comparative tests at different points of cut-off, for we wish to have it plainly understood that this is all the value claimed for this report of tests. What the temperature of the feed water or the flue gases was, has no bearing on the case, nor the average steam pressure, for we are assured that they were practically alike in both cases and the coal was of the same quality, and in short both tests were just alike except that during one the point of cut-off was at 30 inches and the other at 22 inches of the stroke. As this is not a modern plant we may assume the clearance to be 7 per cent., in which we have 1.5 expansions for the former and 2 for the latter cut-off. A counter on the engine registers the number of revolutions made. The tubes were cleaned just before each trial, and in short an honest effort was made to arrive at correct results. For the first test four tons of coal were weighed out and the engine run as long as it lasted, when it was found that it had run 17 hours and 53 minutes, making 55,799 revolutions and pumping 4,742,915 gallons of water, the average number of revolutions per minute being 52, and the cut-off at 30 inches as before stated.

For the second test four tons of coal were weighed out, and the engine run until it was consumed, as before, when it was found that the time was 17 hours and 9 minutes, making 53,104 revolutions, pumping 4,513,840 gallons, the average number of revolutions being 51.6, cutting off at 22 inches. According to this we see that there is a difference of 44 minutes, 2,695 revolutions, and 229,075 gallons in favor of the long cut-off. As we understand it there should be a difference in favor of the short cut-off, but as this is not the case will some of the readers of this paper give some reasons that may account for the results arrived at, as we think that they will be of interest to all?

* * *

CAN I GET A PATENT?

George P. Whittlesey.

This is usually the first question an inventor asks, when he has completed his model or experimental machine and finds that it works all right. To get an answer he writes to a patent attorney, enclosing a sketch or photograph of the invention, and a description of its construction, mode of operation and advantages. Perhaps I should reverse the order and put "advantages" first, because the average inventor gives more emphasis to that side of the question than to the others. The patent attorney, on the other hand, wants to know first of all what the machine does, and secondly, how it does it.

To a man not familiar with the United States Patent Office and its records, it seems a very simple matter to find out whether or not he can get a patent for his invention. He thinks all there is to do is to look at the patents for machines of that kind, and see if there are any like his own. In a certain sense this is all that need be done. But to put the theory into practice is where the rub comes in, as in many other matters. A few facts and figures may be interesting to the readers of Machinery.

The United States patents are issued on Tuesday of each week. The average number issued weekly during the year 1894 was 382. In addition to these there were design patents, re-issues of patents previously granted, caveats, and trade-marks registered. The total for the year was 19,875 patents, 928 design patents, 64 re-issues, 2,286 caveats, and 1,806 trade-marks. These figures are somewhat below the average for several years.

The patent system was inaugurated in 1790. Up to July 28, 1836, the patents were not numbered. There were 9,957 granted during this period. Since the numbering began, on the date mentioned, there have been issued up to and including June 11, 1895, no less than 541,057 patents. Design patents began to be granted in 1843, and now number 24,395. The first trade-mark registered was in 1870, since which time 26,695 have been entered for record. There have been nearly 12,000 patents re-issued to correct inadvertencies, accidents or mistakes in the originals.

This vast mass of material is divided into 213 classes of invention, beginning with "Accoutrements" and ending with "Woodworking Tools." The largest class is carriages and wagons, with over 20,000 patents. The smallest is linotyping, with less than 100. Between these I find air and gas engines, 1,025; clutches, 1,535; conveyers, 1,167; cranes and derricks, 596; gas, 3,060; hardware making, 1,395; hoisting, 5,558; hydraulic engineering, 1,146; injectors and ejectors, 540; journal boxes, pulleys and shafting, 4,352; lubricators, 1,409; machine elements, 4,785; measuring instruments, 9,344; metal boring and drilling, 1,242; metal forging, 732; metal founding, 2,310; metallurgy, 4,685; metal punching and shearing, 1,056; metal rolling, 1,167; metal turning, planing and milling, 2,012; metal-working tools, 3,265; pumps, 4,240; railways and appliances (two classes), 23,808; steam boilers and furnaces, 8,830; steam engines, 8,237; steam engine valves, 2,465; wood turning, 756; wood-working machines, 5,524. These are the figures published by the Patent Office on Jan. 1, 1895.

Each of the 213 classes is subdivided into subclasses, in all more than 8,300. For instance, class 136, steam engine valves, is arranged as follows:

Balanced slide—	Reversing.
Double.	Rotary.
Roller.	Safety.
Cut-off.	Slide.
Gage-cocks.	Steam actuated.
Governor.	Throttle—
Piston.	Electric.
Puppet.	

"Well," says the inventor, "that should make it a very simple matter to find out if I can get a patent. Just look at the proper subclass, and if you don't find my invention that settles it."

Unfortunately it does not settle it. The patents are classified by arts; that is, all the patents for gage-cocks, for instance, are supposed to be put together, (I say "supposed," because there are some gage-cock patents under other subclasses). But when a search is made to determine the patentability of an invention, it is not the art or the class, but the actual construction of the device which must be looked for. A search on a gage-cock must be carried through not only that subclass, but also several subclasses of cocks and faucets under Water Distribution, and possibly into Bottle Taps, Siphons and Bottle Stoppers.

A certain construction of axle skein required a search through Axles, Axle Skeins, Axle Boxes, Hubs, Hub Attaching Devices, Sand Bands and Wheels. An electrical branding iron was searched in Branding Stamps, Electric Body Wear, Electrodes, Applications of Electricity, Electric Heaters and Thermocauters. A tape holder in Clasps, Spools, Ticket Reels, Tape Measures and Packaging Braid. An air-pump governor, in Fluid Pressure Regulators for gas, water and steam, and Speed Governors. A blow-off cock in Boiler Attachments, Boiler Cleaners, Flue and Tubular Boilers, Man-holes, Safety Devices and Furnace Attachments. A pocket axe in Hammers and Hatchets, Knives, Gage Knives, Pocket-knives, Razors, Making Axes and Hatchets, Box Scrapers, Compound Tools, Scythes and Erasers. An automatic rope clamp, in Hawser Clamps, Clothes-line Fastenings, Fire Escapes, Curtain-cord Fixtures, Hitching Posts, Hitching Straps, Clasps, Cleats and Belaying Pins.

These examples taken at random from my note-book, are sufficient to show that the official classification is not a safe guide in making a search. One must rely almost wholly upon his experience and his knowledge of the various arts, so that in hunting for any particular thing, he may be sure to look in every place where it or something like it may be found. Even electrical devices are scattered all over the Office, and one is not safe in confining himself to the two electrical divisions only.

There is another point which must be kept in mind by the searcher, and that is the mechanical equivalent of the thing he has in hand. This is a matter of patent law, and only those accustomed to patent practice are able to properly recognize the value, as a reference, of many a patent which to the untrained eye has no bearing whatever on the invention.

It will be seen, therefore, that a "preliminary examination" is a matter which takes not only time, but skill and experience, and that it is not by any means the simple thing that it appears to be. And when you come to "validity searches" to determine the scope and value of a patent, there is demanded far greater ability and experience, in the careful weighing of claims and specifications, the thorough examination of foreign patents, and the mass of printed publications stored in the Government libraries. But of this I will not say more at present, my object being merely to give the readers of Machinery an idea of what it means to attempt to answer the question, Can I get a patent?

* * *

It is worth remembering that work straightened by pressure in a press is more likely to remain straight in the lathe than when straightened by hammering.

TALLEST CHIMNEYS ON EARTH.

W. Barnet Le Van.

The following table gives the heights of all the chimneys in the world that are over one hundred and fifty (150) feet in height, from data furnished the writer by owners and builders of same.

The tallest chimney which heads the list was built at Port Dundas, Glasgow, Scotland, during the year 1857 to '59. for F. Townsend. It is the highest chimney in the world (454 feet high), and one of the loftiest *masonry* structures in existence. It is, independent of its size, one of the best specimens of substantial, well-made brickwork in existence. In Europe there are only two church steeples that exceed this structure in height, namely, that of the Cologne Cathedral (510 feet) and that of the Strasburg Cathedral (468 feet). The great Pyramid of Tizeh was originally 480 feet, although not so high at present. The United States out-tops them all with its Washington Monument, 550 high, and the tower of Philadelphia Public Buildings, which is 537 feet high.

The Eiffel Tower, at Paris, France, surpasses all other terrestial metal structures with its altitude of nearly one thousand (1000) feet. The "Great Tower," for London, England, in course of construction from designs of Mr. Henry Davey, C. E., will out-top all metal structures, being built of steel, and its extreme height will be twelve hundred and fifty (1250) feet when finished.

The highest and most remarkable metal chimney in the world is erected at the imperial foundry at Halsbrucke, near Frieberg, in Saxony. The height of this structure is 452.6 feet, and 15.74 feet in internal diameter, and is situated on the right bank of Mulde, at an elevation of 219 feet above that of the foundry works, so that its total height above the sea is no less than 711.75 feet. The works are situated on the left bank of the river, and the furnaces gases are conveyed across the river to the chimney on a bridge, through a pipe 3,227½ feet in length.

TALLEST CHIMNEYS ON EARTH.	Height in feet.
Glasgow, Port Dundas, Scotland, F. Townsend,	454
Frieberg, Saxony, Germany, Halsbrucke Foundry,	452½
Glasgow, St. Rollox, Scotland, Tenant & Co.,	436½
Creusot, France, Messrs. Musprath Chemical Works,	406
Halifax, Dean Clough Mill, Scotland, Messrs. Crossley's,	381
Lancashire, Bolton, England, Dobson & Barlow,	367
Boston, Mass., United States, Fall River Iron Co.,	350
Chicago, Illinois, United States,	350
East Newark, N. J., United States, Clark Thread Co.,	335
Barmen, Prussia, Germany, Wessenfield & Co.,	331
Edingburgh, Scotland, Gas Works,	329
Huddersfield, England, Brook & Son, Fire Clay Works,	315
Smethwick, England, Adams Soap Works,	512
Carlisle, England, P. Dickon & Son,	300
Bradford, England, Mitchell Brothers,	300
Greenhithe, Kent, England, J. C. Johnson,	297
Lowell, Mass., United States, Merrimack Mfg. Co.,	283
Dundee, Scotland, Camperdown. Linen Works, Cox Bros.,	282
Creusot, France, Schnieder & Co ,	280
Darwin, North Lancashire, Darwin & Mostyn Iron Co.,	275
Pittsburg, Pennsylvania, United States,	275
Lancashire, Eng., Barrow-in-Furness, Hematite Iron Co.,	259
Bradford, England, Manningham Mills, Lester & Co.,	256½
Manchester, N. H., United States, Amoskeag Mfg. Co.,	255
West Cumberland England, Hematite Iron Works,	250
Lancaster, England, Story Brothers,	250
Cheshire, England, Connah's Quay, Chemical Co.,	245
Bradford, England, Newland's Mill,	240
Boston Navy Yard, Mass., United States,	239
Lawrence, Mass., United States, Pacific Mills,	233
Harwich, Dovercourt, England, Pattrie & Sons,	230
Lowell, Mass., United States, Fremont & Suffolk Co.,	225
Woolwich Arsenal, England, Shell Foundry,	224
New York City, N. Y., U. S., New York Steam Heating Co.,	221
Northfleet, England, F. C. Gostling & Co.,	220
Ivorydale, Ohio, United States, Proctor & Gamble,	218
Lawrence, Mass., United States, The Tower Pacific Mills.	215
Philadelphia, Pa., The Fidelity Insurance Co.,	212
Dewsbury, England, Olroyd & Sons,	210
Lanarkshire, England, Coltness Iron Works,	210
Wilmington, Delaware, United States, City Water Works.	204
Philadelphia, Penn., United States, Finley & Schlecter,	202
Camden, N. J., U. S., Highland Mill, S. B. Still & Co.,	202
Ironton, Ohio, United States, Etna Iron Works,	200
Lamokin, Penn., United States, John M. Sharpless & Co.,	200
Duluth, Minn., United States, Hartman Gen. Electric Co.,	200
Creusot, France, Schneider & Co.,	197
East Newark, N. J., United States, Clark's Thread Mill,	192
Cleveland, Ohio, United States, Ohio Rolling Mill Co.,	190
Nottingham, England, Stanton Iron Co.,	190
Deepear, Sheffield, England, Fox & Co.,	186
Philadelphia, Penn., United States, John Lang Paper Mills,	181
Bayonne, N. J., U. S., Lombard, Ayres & Co. Oil Refinery,	180
Bury, England, Corporation Works,	180
Bradford, England, Corporation Works	180
Prussia, Germany, George-Marienhutte,	180
Crossness, England, Metropolitan Board of Works,	177
Philadelphia, Penn., U. S., Harrison Sugar Refinery,	175
Tacony, Penn,, United States, Erben Search & Co.,	175
Dundee, Scotland, Den's Works, Baxter Brothers,	174
Woolwich, England, Gun Factory,	170
Steelton, Penn , United States, Pennsylvania Steel Co.,	170
Steelton, Penn., United States, Pennsylvania Steel Co.,	165
Paterson, N. J., United States, Wiedman Silk Dyeing Co.,	165
Fall River, Mass., United States, Fall River Print Works,	160
Worcester, Mass., United States, Worcester Brick Works,	160
London, England, Cement Works, Frances & Co.	160
Mexico, Mexico, Cotton Factory,	160
Russia, Paper Mill, Mr. Shekolden,	159
Abbey Mills, England, Abbey Mills Pumping Station,	158
Salford, England, Salford Corporation,	156
Philadelphia, Penn., Worsted Mill, George Campbell,	153
Newark, N. J., United States, Mile End Spool-Cotton Mill,	150
Long Island City, New York, East River Gas Co.,	150
Philadelphia, Penn., U. S., Necomet Fire Brick Works,	150
Lafayette, Penn., United States, Edge Moor Iron Co ,	150
London, England, Proctor & Berrington	150
London, England, North Western Railway,	150
Huddersfield, England, Brooks & Son,	150

The highest artificial structure in America is the water works tower at Eden Park, Cincinnati, Ohio. The floor of the tower, reached by elevators, is 522 feet above the Ohio River. The base is 404 feet above the stream. If the height of the elevator shaft be added to the observation floor the grand total height is 589 feet.

The highest office building in the world is the Manhattan Life Insurance Co., of New York City; its height above the sidewalk is 347 feet, and its foundations go down 53 feet below the same, being 20 feet below tide-water level, making a total of 400 feet. The foundations consist of fifteen masonry piers, and are carried by the same number of steel caissons. The latter were sunk to bedrock by the pneumatic process. The cantilever system was used for the foundations.

* * *

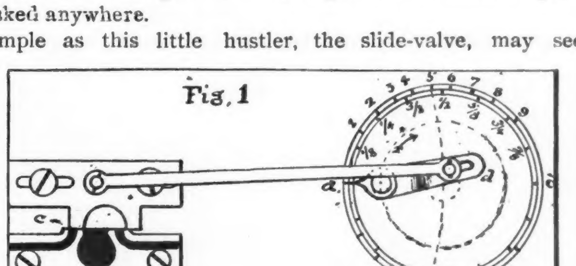
SETTING SLIDE-VALVES--ON PAPER.

"Quirk."

It is safe to say, we believe, that a great many who work around steam engines, in the shop and out of it, take them apart and put them together, and are perfectly competent to adjust a valve and eccentric, so it will take steam properly and run the engine in the right direction, hardly ever give the subject any thought outside of this simple mechanical operation.

The logic which leads to this indifference, where there is any logic in it, is evidently based on the assumption that the designer thinks out this question, lays down lines to be followed, and it is the business of no one, unless it be his employer, to question whether he is right or wrong. This may and may not be sound reasoning. It is certainly the business of the workman to thoroughly understand every function of the various parts of the machines he constructs, or, to say the least, it is his privilege to do so. Having done this it does not follow that he should meddle with matters relating to the drawing room, or intrude opinions unasked anywhere.

Simple as this little hustler, the slide-valve, may seem,



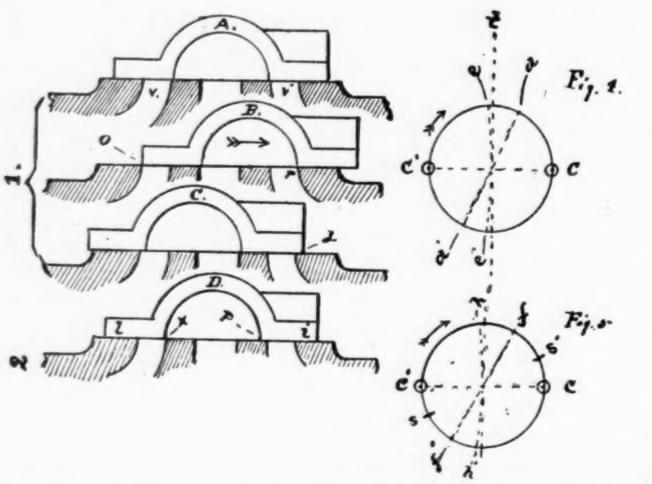
we cannot help regarding it as an interesting study, when we come to consider its various offices and the part it takes in steam economy, and one that will tend to bring into use our best powers of delineation and thought.

It is not my purpose to enter into any of the intricacies of the question at this time, but by some of the simplest kind of illustrations start at letter A, of the subject, as it were, and perhaps at some other time tackle letter B.

The following up of a graphical analysis of a subject like this is quite difficult to some, and to others it is distasteful. To such persons the device shown by Fig. 1 will serve a good purpose. This may be made principally of wood, and may be very simple, or as elaborate as we choose to make it. It is obvious that double

eccentrics and the link motion may be employed in this way. The length of rods, and indeed all other proportions, should conform to that of the engine under consideration. In the cut shown we have employed an unusually short rod, in order to make its angular effect apparent on the motion of the piston, or cross-head.

The stroke of these is here made 10 inches. The point *a* represents the crank-pin. The return-crank *d* is set to revolve in the direction of the arrow, with valve about to open at *c*. It will be seen that the space between 9 and 10 in the path of the wrist-pin is nearly as great as that between *a* and 2, the latter requiring



two inches of piston movement, while the former represents but one inch. The piston therefore travels nearly two inches at the beginning of the inward stroke in the same time that it takes to travel one inch at the terminus of this stroke.

It will also be observed that the fractional parts of the crank motion, as spaced on the inner circle, are not the divisions referred to when designating the point at which steam is cut off. The straight line below shows these divisions. An accurately fitted device of the kind shown will be of much service to beginners in the study of valve movements.

We can better bring out a few points to which attention may be called, by the use of some simple drawing of valves and their seats, as they appear at different points in the stroke of an engine.

The first three valves, A, B and C, in group 1, are actuated by the eccentric shown by Fig. 4. The dead centers of the crank-pin are shown by C′ and C. The valve A having a lap at each end equal to the width of the ports V V′, is placed centrally over these ports. Then to revolve the engine in the direction of the arrow, the center of the eccentric must be at *e*, or midway between C′ and C. Now to place the crank-wrist and eccentric in the proper relations with each other, the former is brought to C′ and the center of the eccentric is turned to *a*. This brings the valve in position shown by B. The exact place for eccentric is a distance from *e* equal to the lap of the valve, so that the port *v*, is beginning to open at O. The eccentric is made fast here and the crank-pin is turned to C. This brings the center of eccentric to *a*′, or exactly opposite its first position at *a*, and the valve is brought to the position shown by C. But something is wrong. The valve C is not opening at *d* as it did at O. Yet the eccentric occupies the same relative position with the crank-wrist that it did at the start.

If we were setting a valve in actual practice on an engine, it would not be so easy to locate our trouble at this point, but we are now setting a valve *on paper*, where points can be more easily located. It might be well for those who think that practical methods are the only ones which are reliable, to make a note this exception.

If we will set the points of a pair of dividers on *a*′ and *e*′ and then transfer this measurement to *a e*, we will find the latter distance as much greater than the first, as the lap of the valve at *d*, and that the angle of the eccentric rod, or the arc from *t* to *e*, furnishes the cause, and that the difference between the vertical line *t* and *e* has been doubled, and this deranges the valve movement just that amount.

There are two ways practiced for correcting this unequal travel of the valve; one is to shorten the end of valve at *d* as much as it laps over the port. This allows the eccentric to remain where first placed, it gives equal lead at each port, and causes the exhaust to take place with very nearly equal intervals of time between. But the plan most generally practiced is to allow the ends of valve to remain of equal length, shift the valve on the stem to the extent of half the lap at *d* and then move the eccentric in the direction of C′, until the desired lead is obtained.

If we now turn the crank-pin to the point shown at S, Fig. 5, the center of eccentric will rest at *h*, or exactly at mid-stroke of the valve movement. Yet the valve will then be in the position shown by D, with unequal lap as seen at *i* and *l*. In fact this will be its position whether the crank-pin rests at either S or S′.

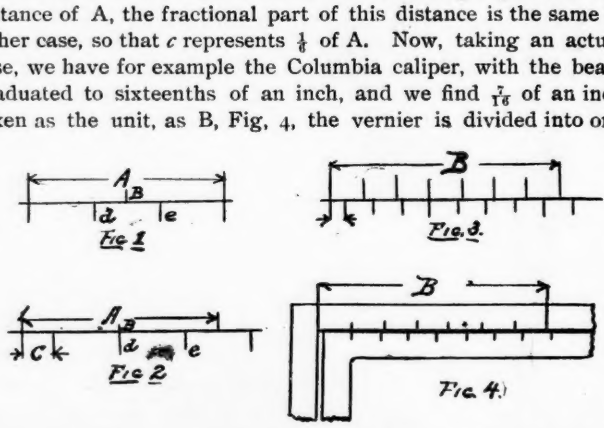
One of the causes for the inequality in the exhaust, which is so apparent in short coupled engines, may be found in the difference in the lap, as shown at *x* and *p* in valve D.

Of course, no pretentions can be made to accuracy in drawings so small as those presented, the object being simply to show in an off-hand way some of the most interesting phases of valve-setting that are encountered at the outset, leaving untouched questions of valve proportions and movements which affect points of cut-off, expansion and compression, exhaust release, back pressure and lead. All these points have been fully dwelt upon by the ablest of authors, and their works are easily secured whenever an inclination arises to know more of this little piece of mechanism, which performs its many functions with such marvelous fidelity and accuracy.

* * *

READING THE VERNIER.

While it is a very simple matter to read a "vernier" when you are instructed for the particular case in hand, it is far better to understand the principle involved, so that any vernier can be correctly read after a slight examination, regardless of whether the instructions are handy or not. Probably the majority of verniers read to tenths, hundredths or thousandths, but the system is not confined to these divisions, as any required fraction can be used. Taking a planimeter which registers $\frac{1}{100}$ of a square inch and we find the vernier or auxiliary scale to be divided into ten parts, whose sum equals nine parts of the revolving scale. We are told to read the decimals by noting which line of the vernier coincides with *any* line of the scale, and this indicates the hundredths of a square inch. But let us analyze this a little. Take any space, as A, Fig. 1, and divide it in two equal parts, then take the same space on the edge of another piece of paper and divide it into *one more part*, three in this case; call this the vernier. Now move either paper in either direction; but to follow this closely we move the vernier to the right as seen in Fig. 2 until *d* coincides with B of the scale. We have now moved the vernier (or opened the caliper, let us say) until one of its divisions (thirds in this case) coincides with the first division of the upper scale (halves in this case), so that we have moved the vernier $\frac{1}{3}$ of $\frac{1}{2}=\frac{1}{6}$ of the whole distance A, or one-third of the distance to *b*. If this distance is 1 inch, then we have moved it $\frac{1}{6}$ of an inch; if A$=\frac{1}{2}$ an inch, then $\frac{1}{12}$ of an inch, etc., so that while the actual reading depends on the distance of A, the fractional part of this distance is the same in either case, so that *c* represents $\frac{1}{6}$ of A. Now, taking an actual case, we have for example the Columbia caliper, with the beam graduated to sixteenths of an inch, and we find $\frac{7}{16}$ of an inch taken as the unit, as B, Fig, 4, the vernier is divided into one



more part, making it *eight* as shown. Now moving the piece carrying the vernier till the first line coincides, we have opened the caliper $\frac{1}{8}$ of $\frac{1}{7}=\frac{1}{56}$ of what? Not of an inch, but of the unit used, which is $\frac{7}{16}$ of an inch, so $\frac{1}{56}$ of $\frac{7}{16}=\frac{1}{128}$ of an inch. Suppose we open the caliper to $2\frac{7}{16}$ inches plus the amount indicated by the fourth line of the vernier coinciding with a line on the scale. We read $2\frac{7}{16}$ inches plus $\frac{4}{8}$ of $\frac{1}{7}=\frac{4}{56}=\frac{1}{14}$ of $\frac{7}{16}=\frac{1}{32}$ or $2\frac{15}{32}$ inches. When we know the smallest division the vernier will read, we do not need to calculate every time, this has been done to show the reason for its use. In this case each line from the

zero point represents $\frac{1}{128}$ of an inch, and when the fourth line coincides we read $\frac{4}{128}$ or $\frac{1}{32}$ of an inch. We might formulate the rule as follows: Take the line on the vernier that coincides with *any* line on the scale for a numerator and the number of divisions in the vernier as the denominator, and this fraction represents the portion of *one division* of the unit used, which is indicated by the vernier. Again taking the Columbia caliper as an example, we find a scale divided to fiftieths of an inch, and nineteen of these divisions are taken as a unit, the vernier of course having twenty divisions in the same space. Move it till the first line of the vernier coincides with the first line on the scale, then according to our rule we have 1 for a numerator, and as there are twenty divisions the vernier indicates $\frac{1}{20}$ of the unit used or $\frac{1}{20}$ of $\frac{1}{19}$ (one division of the unit used) or $\frac{1}{380}$ of the unit used. The unit being $\frac{19}{50}$ of an inch we have $\frac{1}{380}$ of $\frac{19}{50}=\frac{1}{1000}$ of an inch. Knowing that each line of the vernier indicates $\frac{1}{1000}$ of an inch (having proved and not depended on the maker's stamp) we know that if the fifth line of the vernier coincides with any line on the scale, that $\frac{5}{1000}$ are indicated, if the ninth line then $\frac{9}{1000}$, etc. Anyone can be taught to read any particular vernier in a very few minutes, but it is hoped this will make the principle so clear that any vernier can be read, or one constructed for any special work that may require it.

* * *

ERECTION OF MACHINERY.

F. W. Clough.

It is primarily important that any machine of importance be well designed and constructed; but many times well designed and first-class constructed machines fail to do as well as they should simply because of poor erection. The idea seems to linger in the minds of some that iron and steel are materials of strength and consequently are self-supporting, and it does not enter their minds that a machine, at least of large size needs to be set up correctly on a solid foundation. It is a fact that the more weight material there is in the machine, such as iron and steel, the greater the need of a foundation under it to support it permanently in position; and while much may be done in properly designing the frame, bed or column of the machine to approximate the self-supporting feature, yet there remains the necessity of a good unchanging foundation under it, and that the same bed, frame or column of the machine be exactly leveled on the same foundation. Back of all this final setting up of machinery for use occurs the erection during construction, and back of all erection occurs the construction of parts. Let us illustrate: the bed is planed on a planer which stands on three legs (three corners if you please), it may be only a trifle loose on the fourth corner, but that planer leaves its twist, its imperfect straight line surface.

I had just such an experience many years ago, in my younger days. I ran a planer whose table would plane fifteen feet in length, and which was used to plane quite heavy work. The man who set it up was supposed to know his business in that line; but that table never did run correctly and did not fit the V's of the bed uniformly from end to end, and I of course, like many others, supposed that *any planer* must plane straight; but I had trouble to get a high quality of work out of it.

The trouble originated with the planer on which the table or platen and bed of this one were planed. Next, the man who did the planing might not have properly leveled the bed and platen on the original planer, and finally, when set up, our man did not get it accurately enough. Those were the days when very much less scraping and fitting of straight parts was done than now. Oftentimes it is claimed that if parts are not exactly straight, that running will true them up, and finally become correct; but this is not so; as a rule they will become worse for wear. I have known instances where this has been claimed and attempted, and only with unsatisfactory results. Good first-class machines have failed to do required service where they have been left to improper men to set up and to start up. I call to mind a few of the many instances which have occurred in my experience. A certain firm had a machine constructed at one of the best machine shops in the country. It was built first-class in every respect, and at the shops was tested and did the required work just right, and was sent to the manufacturing company, who set it up but it did not do the work correctly. The builders sent a good man to their place to look for the cause of the failure, and he simply found that the machine (a large size one) was not set up correctly; it was not properly leveled up. The builder's man left it in good satisfactory working order, so that later the manufacturing company had other machines of the same kind built.

I recall another case which occurred in one of the best watch shops in the world. They bought a 16-inch so-called (16×16×36) iron planer of first-class make, which was sent to the watch company and set up in their machine shop. They soon informed the builders that the planer would not cut down parallel. The builders asked them to send it back to their shops, which they did, and after it was set up, leveled nicely and tested and found to cut down work parallel, the master mechanic of the machine shop was sent for to come and see the poor condemned planer work where it was made. He came and was satisfied with the quality of the work it did there, but asked why it would not do as well in their shop. A few questions were asked him, chiefly about the footing it had and the leveling when it was started up, and he expressed surprise to think that so small an item as correctly leveling up should make the difference. He was given a few instructions on setting up planers, and planer and master mechanic went back happy to do good service at the watch shop. The only thing done to the planer was correctly leveling it up.

I knew of a certain firm who wanted a superior lathe, one which would keep in position of itself, if it happened to stand on two (out of four) corners and would remain straight; so ordered one of short length and of double depth of bed; but I never knew that they attained the degree of accuracy desired without the same care in placing a good foundation under it, and the same care in leveling up that is needed for a good ordinarily strong bed lathe.

Some machinery may not need so much care in setting up as others, but machine tools do need special care in this respect. The lathe and other tools will not do as good work when poorly set up, and when these items of care are neglected and tools are used out of proper position, they become worn out of true, and are unnecessarily injured. Parts that perhaps were originally exceptionally good are thus injured. A first-class steam engine builder not only considers it quite necessary that the crank-pin be made to run square with the shaft, but that the shaft itself be made to run square with the center line of engine and that the center line of shaft be correctly leveled up on a solid foundation.

The locomotive needs to be carefully set up—leveled up in erection; but of course in subsequent use it is subjected to a severer service than many other kinds of machines, and the only foundation it has outside of its own rigidness of boiler and frame, are the wheels on which it stands, with intervening springs to modify jar and shock to machinery and men. Could it be possible to place the locomotive on a solid foundation such as the stationary engine is privileged to have, no doubt the "wear and tear" of the machinery would be materially lessened, and its lifetime existence (of the machinery) be doubled. The careless man is not fit to set up any class of machinery unless some mechanical missionary has caused a reformation in his ways. Good machines are the product of good live brains and skillful hands, and the day is a long way off when any class of machines or all classes combined will be intelligent enough to originate *anything new*; to build without the mechanic back of it, to give correct directions. No fear of any immediate strikes on their part to send us mechanics off the earth. What they ask of us is to stay near by when they get into trouble or when they fail. Sometimes a good machine seems to almost say "Thank you," when the kind, skillful hand puts it to rights, and it moves on again doing its allotted service (apparently, almost) with renewed ambition. A good foundation under a machine is like a good place to lie down to rest, just a fit; and carefully leveling up is

like having one's pillow just the right height, and then satisfactory results always follow.

* * *

ROLL LATHES AND ROLL TURNING.

A. Randolph.

Few machinists ever have an opportunity to see or learn anything of this peculiar branch of the machinist trade, and yet it is one of the most important and absolutely necessary means by which modern iron and steel works are enabled to produce the many shapes of rolled iron and steel which are used for various purposes.

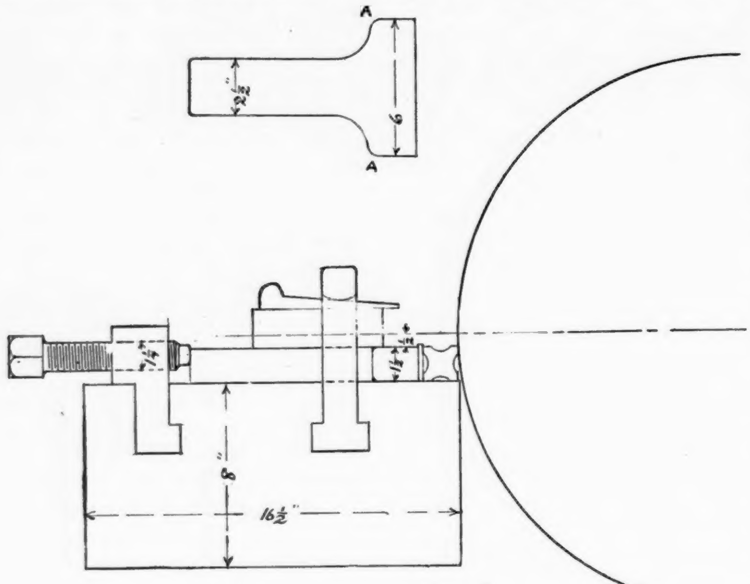
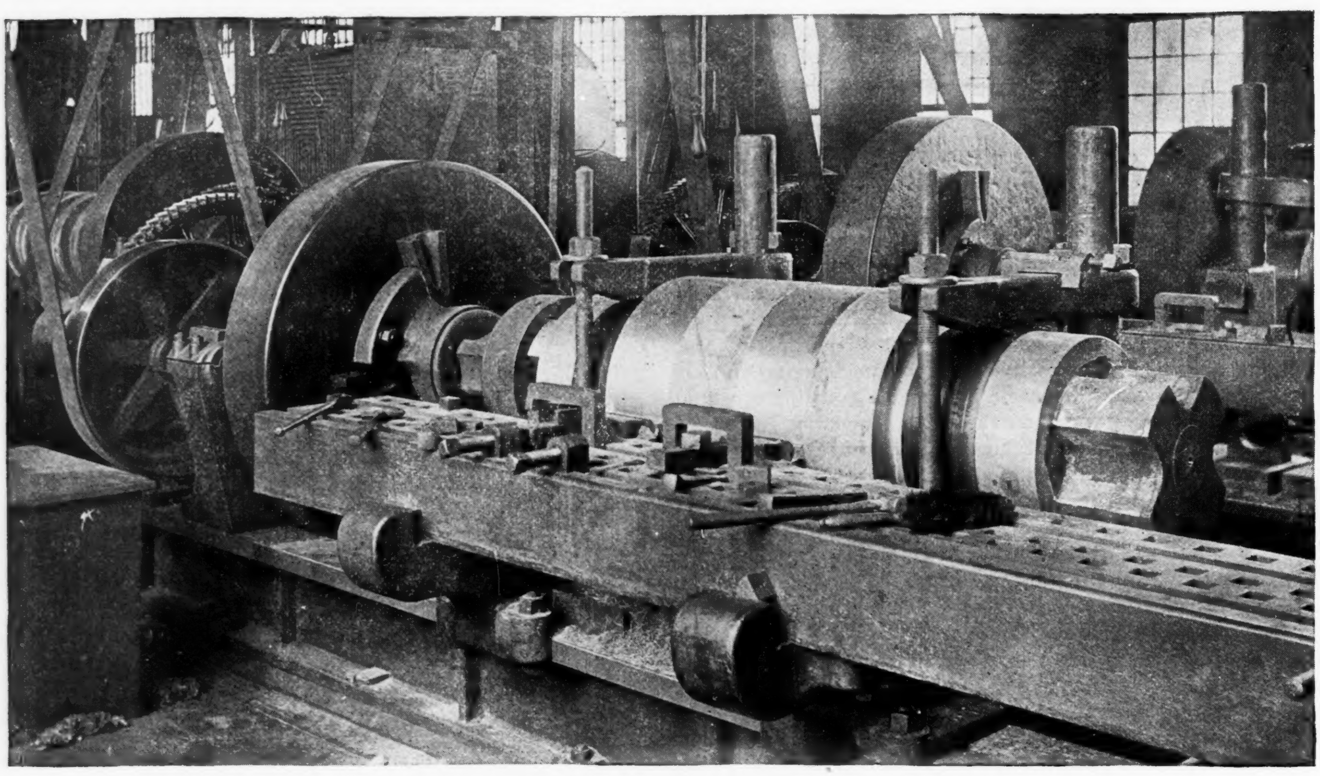


Fig 1

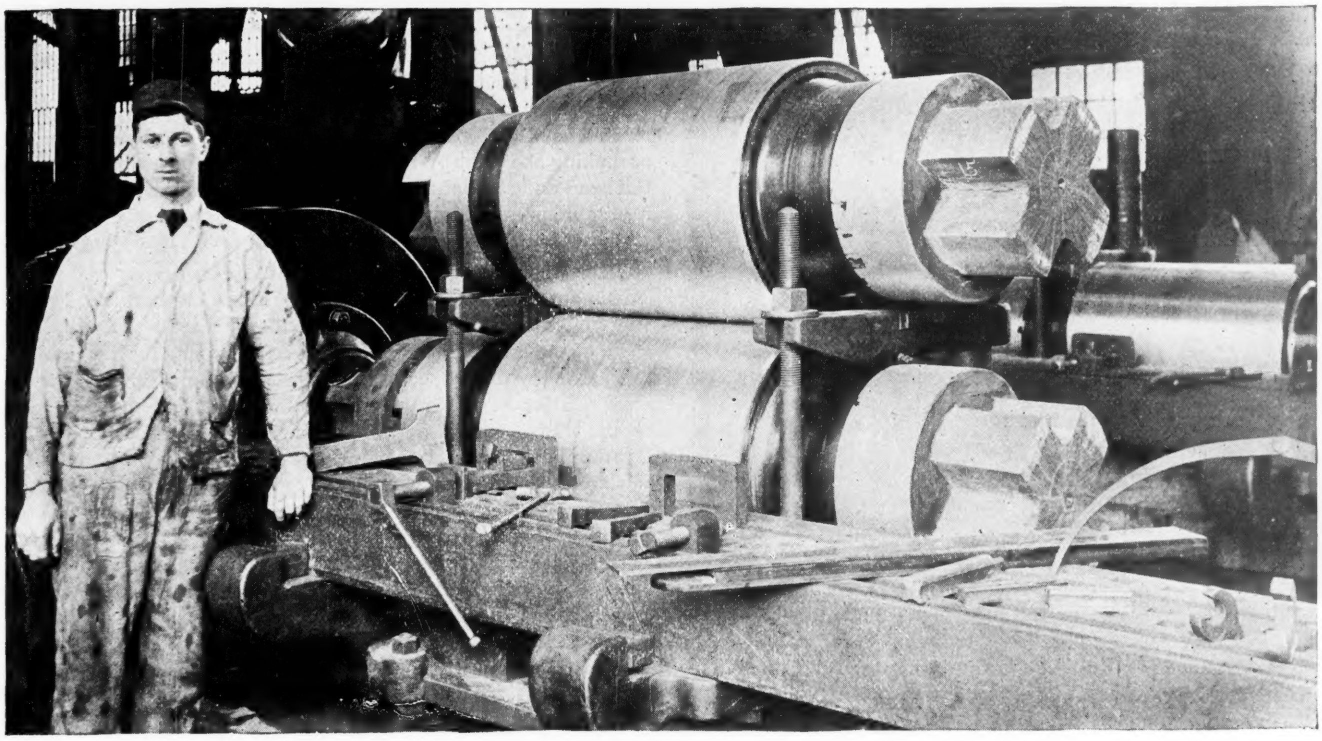
The modern roll lathe is in many respects the most primitive of all lathes. It has no slide rest or other means of guiding a moving tool along a straight or curved path. There are no chucks, mandrels or other accessories of that kind. It is strictly a turning lathe, there being no appliances for boring holes or facing broad surfaces. It has no "live" center, but it will be observed, by reference to engraving showing the gearing, that the face-plate acts simply as a driver, and rotates on a fixed spindle. The tail stock is similar to that on an engine lathe, except that it has no side adjustment. The centers in the roll are made with suitable chisels and finished by a center punch or reamer. The angle of the center is from 80 to 85 deg. The only turning done on the centers is the journals of the roll, the body being finished while rotating the journals in suitable bearings. Roll lathes range in size from 24 inches to 72 inches swing, there being four or at most five sizes. The gearing is usually cast, but few if any having cut gearing. The two engravings showing a lathe with rolls in position for turning, represent a lathe of 38 inches swing. The face-plate gear is 2 inches circular pitch and 75 teeth, and mating pinion 14 teeth. The next pair is 1¾ inch pitch and 60 and 15 teeth, and the last pair 1¼ inch pitch and 88 and 15 teeth. The step pulley has four diameters from 12 to 24 inches for a 4-inch belt. The pulley is geared to run 125 revolutions to one revolution of face-plate, and the slowest speed is generally such that it gives a speed of four feet per minute on the surface of a roll 24 inches diameter. The chief feature aimed at in the design of a roll lathe is to have it strong and massive so it will be as free as possible from deflection and vibrations. It is for this reason no sliding carriage is used, and the tool is held in a positive fixture as rigidly as required. In fact a roll lathe is a special machine for turning rolls, and is useful for that purpose only.

One of the most interesting and accurate jobs done on a roll lathe is that of the rolls shown in the engravings. They are rolls for rolling tin plates and fine sheet iron, and are 24 inches diameter by 32 inches long in the body, with journals or necks 18 inches diameter and 15 to 16 inches long. The surface of the body is chilled, so that when finished the chill is from ⅝ to ¾ inch thick. The tool used for this work is 8½ inches long by 1½ inch square, and of shape shown in Fig. 1, which shows the tool in position for cutting and the manner of holding and forcing it to the roll. A piece of copper is placed between the tool and the pusher to protect the edges, and all four corners of the tool are used before being reground. The tool is fed to the roll until it has a clean cut its full length all around the roll, and then the operator calipers to find if it is parallel. If not he slackens the feed-screw slightly and with light taps of a hammer at A, Fig. 1, he adjusts until it turns parallel. The final test of accuracy is made with a hardened steel straight-edge, which is rubbed lightly with fine chalk, and lying flat on the tool-rest at height of center of the roll, it is rubbed gently end-ways to mark the roll. Rolls of this kind are always used in pairs, and the second roll of the pair having been



Roll Turning—Two Tools at Work—Robinson-Rea Mfg. Co.

roughed out to near the right size, the first one finished is mounted above it as shown in the engraving, and set in a crossed position so that when one end of the body of the top roll is directly above the center of the bottom roll, the other end of the top roll is set back 1½ inches. In this position it is held so it is free to revolve, but otherwise it remains as placed. The bottom roll is then turned until it fits the upper one the entire length so accurately that light cannot be seen by looking between them. The high spots on the bottom roll are marked by rubbing of the top roll, which, owing to being crossed, is compelled to slide end-ways on the lower roll as it revolves. No machinist needs to be told that it requires experienced skill to do such accurate work with such a tool and means of adjustment. When the rolls are set parallel with each other after being finished, they stand apart at the center about .012 inch. The reason this shape is required is because, when they are in use they become the hottest at the central portion and expand the most there. The amount of this expansion depends on the quantity and heat of the material rolled, and the consequence is they will not roll accurately until brought to and kept at a heat that will roll the sheets parallel. The thinnest sheets are finished in a pile of eight, so that a slight error of the rolls would only produce one-eighth of the error on each sheet that would be produced if one sheet at a time was finished.



Turning the Second Roll—Robinson-Rea Mfg. Co.

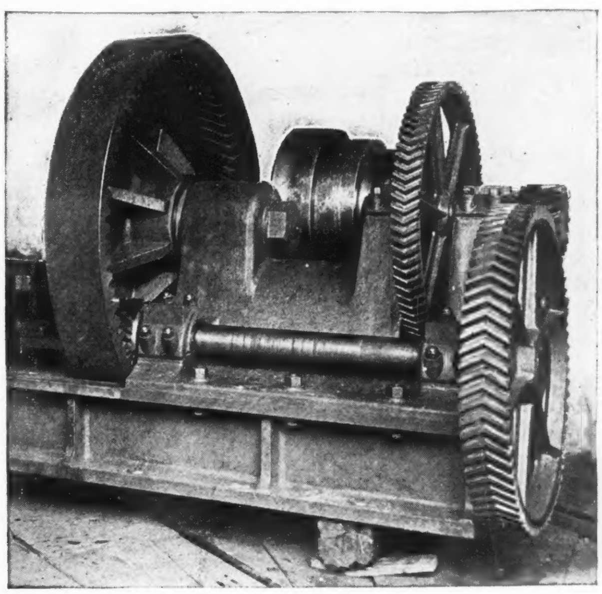
These chilled rolls are very hard and can only be turned at a speed of about 40 to 48 inches per minute. It requires from ¼ to ⅜ inch diameter to be turned off, and a tool 8 inches wide requires about four and a half hours to cut to $\frac{3}{16}$ inch depth. This takes off the metal at the rate of six lbs. per hour, and as two tools are cutting at the same time it makes twelve lbs. per hour.

Rolls that are not chilled are made of very strong close iron, and can be turned at a speed of 10 feet per minute. On the lathe described 100 to 110 pounds of iron per hour can be cut from rolls not chilled.

It will be noted that the rolls being turned on the body are driven by a short spindle connecting to face-plate, which is used to give some adjustability in the driver, so that if the roll is not set exactly in line with spindle the accuracy of rotation will not be affected.

The tools used for turning grooved rolls of various kinds are generally formed tools of the required shape to finish each groove at one cut, but the grooves are first roughed out with heavy tools having wide cutting surfaces and small top rake, the tool being supported by an iron post directly beneath the cutting edge, which post rests on a heavy plate lying across the lathe shears. All tools which project more than an inch or so beyond the rest are always supported by such a post, so they cannot spring under a heavy cut. Where facing is needed, such as the ends of the roll body, a heavy side-cutting tool is used, and is fed to the work by set-screws which go through the posts that fit the square bosses in the rest, one screw at front edge of the rest to feed the tool side-ways, and another at rear end of tool on opposite side to prevent the tool from twisting around on the rest.

The same housings or stands are used for smaller sized necks, by putting chucks of the proper thickness in the brass seats, and inserting the brasses in the chucks. The bottom brasses have a set screw to keep them against the end of the roll so it cannot move end-ways. The top brass is in an arm that fits easily on the post at the back, and the bolts in front can be removed so the arm will swing around far enough to allow the roll to be lifted out of place without moving the housings. For very heavy work another kind of housing is used, which resembles the center rest of an engine lathe, but is very heavy, and has a gap in which the tool rest is held so it can be adjusted up to different sized rolls.

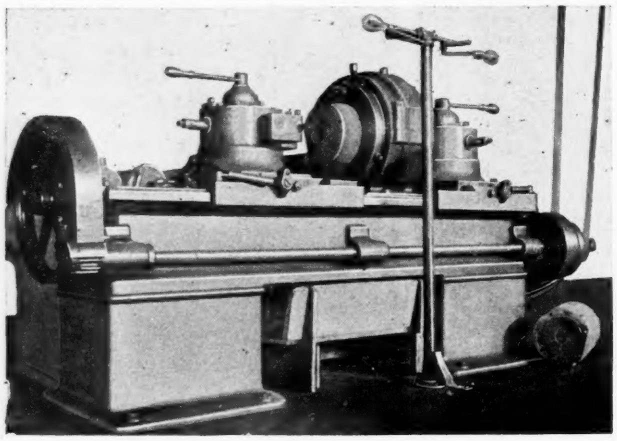


Gearing of Roll Lathe—Robinson-Rea Mfg. Co.

The engravings shown are made from photographs of lathes in use and built in the shops of the Robinson-Rea Mfg. Co., Pittsburg, Pa. They have twelve roll lathes in use in their shops, all of their own build, and the present proportions are largely the result of their own experience in the use of them.

AMONG THE SHOPS.

The shops of the Westinghouse Air Brake Co., at Wilmerding, Pa., about seventeen miles out of Pittsburg, are quite noted for their various departures from ordinary practice. Beginning in the iron foundry the visitor finds a building which seems to be all light and which is equipped with machinery that is novel and interesting. The sand is all handled by conveyors and is delivered through a chute to each moulding machine. Running the entire length of this moulding floor is an endless train of small platforms or cars, about 320 in number, each large enough to carry one flask. This train, if it can be so called, runs beside the



Double-Ended Turret Lathe.

moulding machines, and as the moulds are made, the halves are placed on these cars as they pass, carrying them around to the core table, which is a raised platform inside the "endless belt."

The cores being made up-stairs are sent down by a conveyor and placed in the molds, which are then closed, and they pass on to the cupola, where they are stopped long enough to be poured; then they pass on, and when the other end is reached the flasks are taken off and dumped, the average time between the pouring and dumping being seven minutes, on the work under way at the time of the visit, the work being reservoir cylinders, which are very uniform in section. These castings come from the mould red hot and are piled up to cool, an operation which must have a "chilling" effect, and would hardly be permissible on castings requiring much machining. There are two sets of these traveling tables, and on these particular castings the output is about thirty per hour, making a big day's work from a comparatively few men. The brass foundry is equipped with moulding machines and all conveniences, but there is no call for the endless train arrangement here. The machine shop is well equipped with modern tools specially adapted for their work, one of which is shown for facing both ends of the reservoir at one operation. The casting is held in the central chuck and revolved by it, while the ends are operated on by the special tools in the turret heads shown.

Fig 3

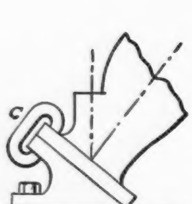


Fig 1.

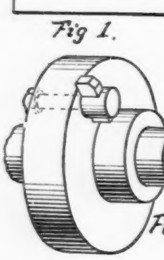


Fig 2

A handy clamp for holding castings at an angle for drilling is shown in the line sketch, Fig. 1, the angle block fastened to the drill table to give the right inclination and the clamp *c* simply slipping over the flanges to overcome the tendency of casting to tip over, this being sufficient to hold it while being drilled. A surface grinding machine which has the wheel mounted on a head very much like the ram for a shaper, which carries the wheel back and forth over the work as it (the work) is fed in the usual manner. The castings, which are subjected to an air pressure, are treated to a half hour's bath in hot paraffine, which is said to effectually close all the pores of the casting and make them perfectly serviceable where they would otherwise have to be rejected.

The pump cylinders are bored in horizontal mills, with two bars built on the plan shown in Fig. 2, the cutters held by slotted bolts, only one cutter being shown in place, although three are usually used.

In the brass-working department there is much to interest the mechanic familiar with Fox or turret lathe work, and it was rather a pleasing as well as a novel sight to see quite extensive window gardens in this department, with the plants evidently in a thriving condition. The air-pump testing room, as well as the room where the brakes and valves are tested, are very interesting and show the thoroughness with which these important railway appliances are inspected, the exacting service they must undergo rendering this necessary, at the same time being an economy in the long run.

For small tanks or reservoirs, usually made of sheet metal riveted as in the ordinary log boiler, they have adopted the plan of making the joint by rolling the bead shown in Fig. 3, in both the head and shell of tank. This is done by hydraulic pressure in a suitable press and makes a very neat job, as well as one which is giving better satisfaction than the old method.

WESTINGHOUSE ELECTRIC AND MANUFACTURING CO.,

It is but a mile or so to the new shops of the Westinghouse Electric & Manufacturing Co., which are hardly yet completed, some of the larger tools not being placed as yet. While these are not yet ready for inspection, they present some very interesting details, a few of which will be mentioned. White paint abounds on the walls, ceilings and all passageways, adding much to the light and comfort of the place, but they have not adopted it for machine tools, and perhaps in their open location, with plenty of light on all sides, they do not need it. The buildings are well adapted for manufacturing of this kind and are well equipped with cranes and hoists for handling material, this being now realized as being one of the large items of expense in many places. One of these, which struck me as being particularly novel and applicable to almost any shop, is shown in Fig. 4. It might be called a portable crane, for it is on large castors, has a small hand hoist, and the base being open and low can be run both sides of the object to be lifted, and after lifting it can be run close to the lathe (the base going underneath) while it is being transferred to the lathe centres. Its use will be suggested in many instances and it will prove a good investment for almost any shop. Milling machines are used extensively in much of their work, the street car motor cases being milled at one passage of the mill, those built by the Ingersoll Co. being in the majority and doing good work at a rapid rate.

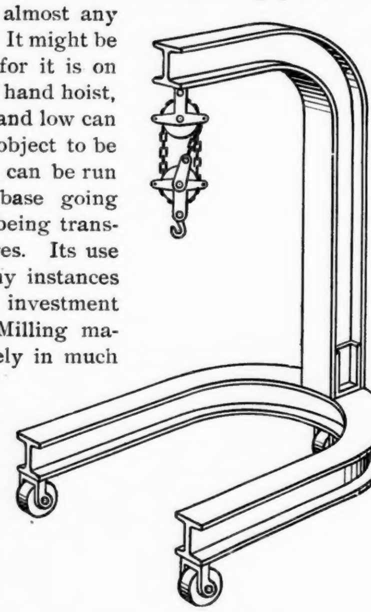


Figure 4.

Fig. 5 shows a face mill with a twist drill in the center, driven in the usual way. This is used in making the frame of arc lamps, the castings being put in a clamp and one end presented to the tool, the drill comes into play, and after this the clamp and frame are reversed when the mill faces the other end, making quite a handy combination.

The shop transmission is divided into sections, each section having an independent motor of the Tesla type, which is to be the type used in connection with the Niagara Falls plant. These were running nicely and seem to be a very compact machine, with little to get out of order, in fact just the machine for this kind of work. Special tools abound, and among these are multiple drilling machines with spindles too numerous to count, each driven by a double universal joint, so as to allow adjustment for different sizes of jigs, for jigs are used with them to insure greater accuracy than could be obtained by depending on the setting of the spindle alone. Another feature which is being developed here is broaching, and this is not limited to square or peculiar shaped holes, but even round holes are finished in this way in many instances. This has not reached its full development as yet, but is being gradually worked up in the belief that it contains possibilities which may produce better and more economical results than we are accustomed to find. The manufacture

of street car motors has been almost reduced to a science, and the equipment for making them is far different from the days when they were in an experimental stage. Armature discs are stamped by the thousand, built up on the shafts, finished, wound, shellacked, baked and made ready for the motor much as lathe cones are turned out in a large lathe shop. The fields undergo a similar treatment, are milled, bored, drilled and the magnetizing coils, already wound on spools, are dropped over them, with little if any of the experimenting which characterized the making of electrical machinery a few years ago.

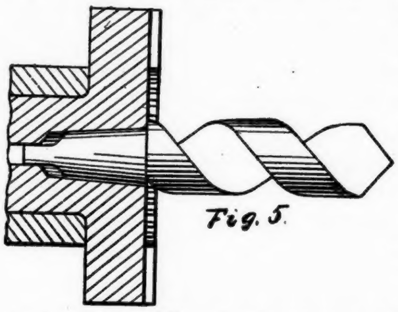


Fig. 5

At the time of my visit work was progressing on the last of the Niagara generators, and the large machines were being handled with ease on the erecting floor. In the blacksmith shop copper is forged to some extent. The winding of armatures is reduced to the simplest possible operation by shaping the wires or bars under a drop hammer to the proper shape for the armature, and they are then insulated and placed in the armature slots, making quite a departure from the old method of threading wires through the interior of a Gramme ring, or winding layer after layer around the armature, often a job requiring days for its completion.

* * *

THE ROUND BELT.

John H. Cooper.

The round belt is frequently discussed, and against it some have "lodged a complaint," but enough is left to say a word in its favor, especially when the sphere of its action is confined within certain limits, which is a phrase which fits with equal force to everything else. That domain of best service, over the bounds of which it is not profitable to go, that is, the "limit of elasticity," which, if passed, a penalty is to be paid, applies to this organ of power transmission as to any other.

Now, while it is true that a belt for service must have freedom of bending without loss of strength, and it must have certainty of adhesion without sticking or slipping, it is equally true that the first of these propositions means *thinness* of substance for best effect which the round belt does not possess; but the second proposition is most admirably secured by the wedging action of the round belt in the angular groove of pulley.

In a general way, however, we are safe in saying, the round belt occupies less room for its installation and running and requires lighter pulleys than do flat belts; it will work with little or no loss of efficiency when the connected shafts are slightly out of line with each other, where a flat belt would not stay on its pulleys, and indeed it may be led to and from pulleys at considerable angles, without the use of guiding pulleys, thus favoring certain special devices for which a flat belt cannot be made to answer.

Round belts for best driving must necessarily be limited to the transmission of small powers; their durability will depend upon the quality of the material of which they are made, a statement of general application, but particularly applicable to this form of belt because it is more severely punished by bending than flat belts.

Authorities of note have had their say about round belts and the manner of using them, of which notice is here taken.

Referring to the grooves in which round cords of any material are to run, translating Armengaud, we have: "The angular shape of groove is preferred, in order to increase the adhesion of the cord, which is thus pinched between the inner surfaces of the groove by the primitive tension it receives, similar to ordinary belts. The angle of the groove is made ordinarily at 60 deg."

Fairbairn says: "Round belts of cat-gut, or hemp, are sometimes used, running in grooves, which are better made of a triangular than a circular section, so that the belt touches the pulley in two lines only, tangential to the sides of the groove. In this case the friction of the belt is increased in proportion to the decrease of the angle of the groove."

In all these references to grooves of the pulleys, no mention is made of the better plan of making the sides of the groove *concave* instead of flat, by which increased area of contact is obtained; by this suggestion a semi-circular bottom, which the belt touches, is not meant. The contact and driving area of the belt must always be at the sides, never on the bottom of the groove, except in the case of pulleys for merely carrying the belt. The shape of the groove may be that of a gothic arch, or made by two circular arcs or arcs of other curvatures, meeting in a point or fillet below the belt. More contact is certainly obtained when a flexible circle rests in a concave than on a flat surface.

There is a difference of opinion as to the proper angle of the V grooves; 40 deg., 43 deg. and 45 deg. and even 60 deg. has been named for the inclination of the sides. With the angle of 40 deg. the friction of the rope upon the sides of the groove amounted to nearly *three* times as much as if the rope were working on the surface of a plain drum without grooves.

Some of these experiments were made for ropes, but I conceive that the same forms would give like results for round belts of leather, since the chief object is to produce the greatest amount of adhesion with least sticking upon a yielding cylindrical body of a given diameter.

Wedding, a machine manufacturer in Berlin, found by experiment that the resistance of a rope to sliding in a V-grooved wheel of 60 deg. angle is double the resistance that the same rope meets when in a semi-circular groove which it just freely fits.

A correspondent says: as regards the driving power of round belts, "We have seen one of an inch diameter doing for years a work which proved too much for a 7-inch flat belt." Other experiments show that a ¼-inch round belt is more than equal to a 1-inch flat and a ½-inch round more than a 3-inch flat. In accepting these results, while the possibilities of adhesion are clearly demonstrated, nevertheless, to what extent of time durability survives this ordeal we do not know, a desirable limit may be met, perhaps, if the material be good, since there is "nothing like leather," we must be sure that our round belts are made of the stuff that proves its worthiness of such a superlative.

The driving of the ¼-inch and ½-inch round belts noted above, is out of all proportion when the sectional areas and the pulley contacts are compared. The areas are about 3 to 1 and the contacts 4 to 1 for the ¼-inch and 6 to 1 for the ½-inch belts; all in favor of the flat belts. Truly there's nothing like leather for defeating calculations and demolishing proportions.

The principle of increased diameter of pulley and consequent greater velocity of belt holds equally good for the round as for the flat belt. The round belt is at a greater disadvantage from thickness than the flat belt, and for this the increased diameter and speed brings to it the double advantage of less bending and less work. There is also less space occupied and less weight in motion.

It is needless to say that the joinings of the ends of round belts is difficult, for the joining device should not only pass the groove without jamming, or noise, but be equally strong with the belt itself and susceptible of ready adjustment.

Finally, the plain advice may be here given, as for all power belts, use good material and a fair proportion of it for every power transmission, and never use less than will overcome starting frictions, so as to avoid destructive abrasion of the driving surfaces, since round belts are more severely taxed in this particular than flat ones; remembering also that more allowance of belt than is necessary will burden the machine with a useless load and not contribute to its better driving.

* * *

AS OTHERS SEE US.

"I never could see," said the doctor to his brother, who was a draftsman, "how a man could be contented to sit all day and just make lines on paper. It would be very dull music for me and I can't see where the ambition comes in." "And," said the draftsman, "I never could be contented to squeeze people's wrists, sort out a lot of little square papers and jounce a little powder out of a bottle on each piece, thinking all the while that it was about even chances whether I killed the patient or not." "But," said the doctor, "we have to *know what to put in those little papers*; any one can wrap up a little powder." "And," said the draftsman once more, "if we didn't know *where to draw lines and how long to make them*, you wouldn't ride sixty miles an hour to a hundred dollar consultation. Any one can make marks on a piece of paper." And the doctor allowed there might be something in drafting after all.

Entered at the Post Office in New York City as Second-class Mail Matter.

MACHINERY,

A practical journal for Machinists and Engineers and for all who are interested in Machinery.

PUBLISHED MONTHLY BY

THE INDUSTRIAL PRESS,

411 AND 413 PEARL STREET, NEW YORK CITY.

ONE DOLLAR A YEAR, - - - - - TEN CENTS A COPY.

FOREIGN SUBSCRIPTIONS ONE DOLLAR AND A HALF A YEAR; POSTAGE PREPAID.

CHAS. CHURCHILL & Co., Ltd., London, Agents for Great Britain.

THE RECEIPT OF A SUBSCRIPTION IS ACKNOWLEDGED BY SENDING THE CURRENT ISSUE.

MAKE ALL REMITTANCES TO THE INDUSTRIAL PRESS.

THE TRADE SUPPLIED BY THE AMERICAN NEWS COMPANY OR ITS BRANCHES.

WE CANNOT SUPPLY BACK NUMBERS.

Fred H. Colvin, Editor.

F. F. Hemenway, Consulting Engineer.

William H. Wakeman, Walter Lee Cheney,

Associate Editors.

CONTRIBUTORS.

T. R. Almond.
Sven Anderson.
Leicester Allen.
Daniel Ashworth.
Frank H. Ball.
John H. Barr.
Wm. M. Barr.
"Bell Crank."
Peter H. Bullock.
E. A. Beaman.
Amos H. Brainard.
Henry A. Boyd.
W. H. Booth.
F. Ruel Baldwin.
C. H. Benjamin.
Rolla C. Carpenter.
Francis W. Clough.
Robert Crawford.
John H. Cooper.
William Cox.
James Christie.
F. H. Daniells.
P. S. Dingey.
G. W. Dickie.
W. D. Forbes.
Geo. L. Fowler.
Frederick Fosdick.
Lester G. French.
S. W. Goodyear.
George B. Grant.
Samuel Green.
Jason Giles.
"J. T. G."
John J. Grant.
Robert Grimshaw.
George Guntz.
S. Ashton Hand.
Clemens Herschel.
Henry Hess.
James C. Hobart.
James F. Hobart.
Milton P. Higgins.
James Hartness.
S. Olin Johnson.
"Jarno."
W. J. Keep.
Strickland Kneass.
W. Barnet Le Van.
W. B. Mason.
E. J. Mosher.
A. K. Mansfield.
M. D. Nagle.
H. M. Norris.
Howard A. Pedrick.
Thos. P. Pemberton.
Fred H. Perry.
W. E. Partridge.
"Quirk,"
W. B. Ruggles.
Richard H. Rice.
John M. Richardson.
F. Riddell.
Geo. I. Rockwood.
Henry H. Supplee.
Coleman Sellers.
"Spike."
Joshua Stevens.
Oberlin Smith.
N. J. Smith.
B. F. Spaulding
John E. Sweet.
R. D. O. Smith.
Walter B. Snow.
Theo. F. Scheffler, Jr.
Fred'k A. Scheffler.
L. S. Starrett.
B. E. D. Stafford.
John T. Usher.
Amos Whitney.
Jay M. Whitham.
D. E. Whiton.
Edward J. Willis.
Geo. P. Whittlesey.
Thomas D. West.
Warren E. Willis.
Samuel Webber.
Wm. O. Webber.

THE editorial and news columns of this journal are not for sale, and under no circumstances will any matter be inserted therein for pay, or in consideration of advertising, or on account of the purchase of copies of the paper.

WE solicit communications from practical men on subjects pertaining to machinery, for which the necessary illustrations will be made at our expense.

ALL copy must reach us by the 10th of the month preceding publication.

Subscription Rates for Clubs

IN THE UNITED STATES AND CANADA ONLY.

5 copies one year	$4.50	50 copies one year	$30.00
10 " " "	8.00	100 " " "	50.00
25 " " "	17.50	500 " " "	225.00

One additional copy is sent free to the person who organizes the club.

The above rates are offered to induce the mechanics in every shop and the engineers in every society to subscribe collectively for MACHINERY. No one connected with the mechanical trades should be without a paper, when a good one can be obtained for so small a sum.

THIS PAPER HAS THE LARGEST CIRCULATION OF ANY PUBLICATION IN THE MACHINERY TRADE

SEPTEMBER, 1895.

For two dollars and fifty cents sent us this month we will enter a paid up subscription for MACHINERY to any address in the United States or Canada for FIVE YEARS, and mail a receipt covering that period. No matter how large the paper grows, how frequently it is issued, or what the price may rise to in the interval, two dollars and fifty cents (sent this month) will pay for it till September 1, 1900.

* * *

MESSRS. CHAS. CHURCHILL & Co., Ltd., 21 Cross street, Finsbury, London, Eng., are agents for this paper in Great Britain. Subscriptions sent to them will receive prompt attention.

* * *

IN addition to a large increase in the number of practical articles pertaining to the shop and engine room, we inaugurate a series of articles on *Machine Shop Arithmetic* which, after considerable observation in and out of the shop, we believe will be appreciated by those who have not had other opportunities in this direction. Many, having advanced far beyond this portion of a mechanic's education, may consider them too elementary, but we ask their indulgence while we help the less fortunate to "catch up" with them, and ask their aid in making it a valuable assistance to those who wish to profit by it. Let us know what points puzzled you, for they are almost sure to be vexing the brain of some other fellow who is climbing a few rounds below you. Under the heading *For the Note Book*, we shall present such data, rules, formulas, recipes and other information as seems suitable for the note books of readers of MACHINERY, endeavoring to give enough variety to suit all the classes of work represented. In this connection we shall be pleased to receive practical rules, formulas and data which has been found useful in practice, or to have inquiries concerning anything that appears therein. We shall give credit to the sender, of any information we use, but will *not* publish the names of inquirers (unless requested to the contrary), so that your shop-mates need not know whether you are Solomon or the other fellow, so far as wisdom goes; and if you ask enough questions of the right kind (and not so hard we can't answer 'em) you'll know more than they do inside of a year, if you don't already. The man who never asks questions doesn't know it all, sometimes he doesn't know enough to ask one intelligently.

* * *

DURING the month of September we will enter three subscriptions in the United States and Canada for one year on receipt of two dollars. This does not apply to renewals, as the subscriptions will commence with the current issue.

* * *

THE POOR LOCOMOTIVE.

We are once more being treated to a wave of electrical delirium tremens which is affording the writers of such "scare" headlines as the "Death Knell of Steam," "The Mystic Motor," and "Railroads Alarmed," a chance to show their ability (?) and all because the Westinghouse Electrical Mfg. Co., and the Baldwin Locomotive Works have entered into a purely business arrangement, whereby each is to give the other such parts of any contract as they are best equipped to make. That is, if a railroad wishes to equip a suburban line with electricity, the Baldwin Works will make the running gear and similar work, while the Westinghouse Company will furnish the electrical equipment. This is enough, however, to make "Watts invention of steam, doomed," as one paper had it; showing ignorance of both history and mechanics, as Watt unfortunately failed to "invent" steam, and as the demand for steam engines would be enormous if all railroads were to adopt electricity. But with the locomotive doomed on paper, as it has so often been before by the visionary advocates of electricity, it is easy to fill pages with the things which might happen—but probably will not for several days to come. If all this stuff were true, our esteemed friend *Locomotive Engineering* would either have to tack the word "electrical" before its name or devote itself to a declining constituency, until with thewailing toot of the last locomotive its days of usefulness would be over.

The ridiculous statements made would be amusing if they were not so misleading to those whose mechanical ideas on such subjects are very vague, and who seem to think the word "electricity" makes everything possible, and that putting a "mystic motor" on a car is all that is necessary to make it run at "lightning speed"; forgetting that the motor alone is as helpless as a steam engine without steam or a fly on a piece of "tanglefoot." Briefly stated the case is this: Can electricity now be economically substituted for steam locomotives in all the conditions of service? The writer does not hesitate to say no, with a big N, and is sure this opinion will be correct until the time comes when

the electric current may be generated without the dynamo and steam engine. It is not a question of the *kind* of power, but of the *cost* of it, and as long as the losses of transformation from coal to heat in the furnace, water to steam in the boiler, steam to mechanical energy in the engine, mechanical to electrical energy in the dynamo, in transmitting a long distance to the motor and again transforming to mechanical energy must occur, there can be little hope of relegating the "wasteful" locomotive to the "scrap heap," which has been its proper resting place so long, in the eyes of Lieut. Sprague and others of note who have indulged in this harmless pastime for the past ten years.

While the locomotive can never be as economical as a large stationary plant, owing to the very different conditions, the first cost per unit of power is much less, the last two transformations are avoided; there is no expensive trolley line and its feeders, no bonding of rails, with the return conductor, and last but not least, it is independent of any central station, is not rendered helpless by a broken trolley wire or feeder, and can manage to run with one side knocked off and divested of sundry other useful parts, despite the statement by some of its enemies that "the breakage of any part entirely disables it." For suburban or rapid transit work, where light trains and frequent service prevail, there is little doubt as to the economy of the electrical method of operation, for it seems that power can be more economically subdivided into small units by this system, although the test of time will give more reliable figures in regard to the Nantasket road than can be obtained by "guessing" at present.

The substitution of electricity for steam locomotives on a road only as long as the New York division of the Pennsylvania, ninety miles in length, involves more of an expenditure of labor and money than many seem to realize. Immense power houses must be built at more or less frequent intervals, and each must have enough surplus power to carry a part of, if not all, the load of the next station in case of breakage, burning, or stoppage from any cause in any station; for the road's traffic must go on regardless of blowing out a pipe fitting or even a cylinder-head. Such things occasionally happen in locomotive service and only delay *one* train; when a whole section of road depends on it the case is altered, and breakdowns which delay traffic must be avoided at any cost. The writer is not an opponent of electricity, but rather a friend, who does not wish to injure its chances of useful service by proclaiming it perfect and a panacea for all railway ills. No one man, machine or motor can perform all kinds of service to the best advantage; each has his or its place where the best results will be obtained, and though each may be developed for extended use, great modifications are necessary. This is not a question of faith or of prejudice, but of dollars and cents. When, then, the makers of electrical apparatus have faith enough in their motors and equipment—and backed by a sufficient amount of cash—to guarantee its economical operation as compared with the poor out-of-date locomotive, there will be opportunities presented for a complete trial. In most of the roads so far equipped the conditions have warranted the use of electricity on account of freedom from noise, steam and smoke, even at an advanced cost of operation, and it is an open secret that one of the largest elevated railroads in the world would willingly pay several per cent. more for cost of operation by electricity if it could be guaranteed.

* * *

WE are informed by Mr. S. T. Johnson, secretary of the Western Foundrymen's Association, that there will be no meeting in August; arrangements are being made to hold the September meeting in Milwaukee, Wis., particulars of which will be announced later.

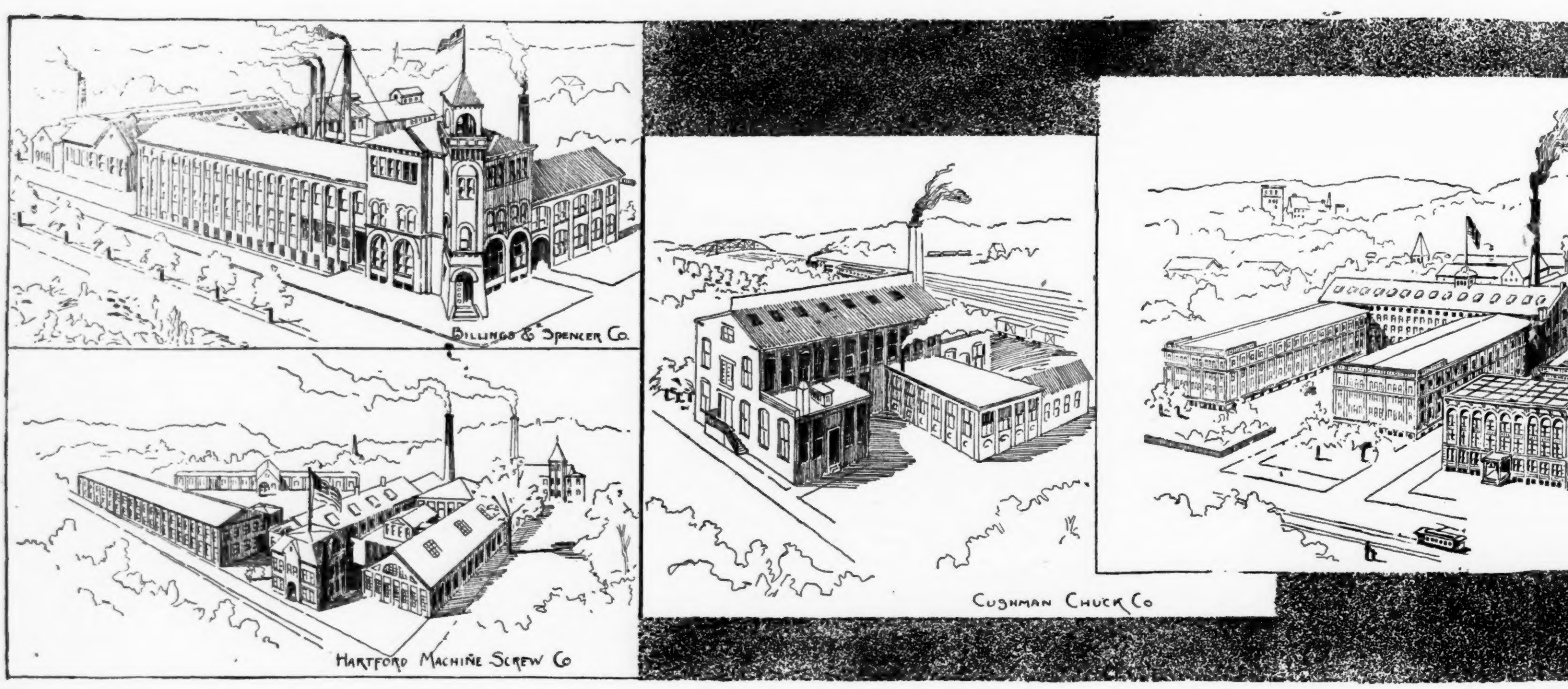
NOTES FROM NOTOWN.—3.

ICHABOD PODUNK.

A young fellow who used to work beside me in the shop has been "called," as the preachers say, to a good position in a good shop in the next town. The place used to be good, but had fallen behind in tools, methods, etc , until it was hard work to keep afloat, and knowing that Joe Barnes was a likely chap they gave him the job of building things up. Now a job like this has two (or more) sides: you can get glory and cash if you do succeed, and demnition (and also fired) if you don't. You have a good chance to improve things generally, and on the other hand the firm too often expects a shop of this kind can be changed from ancient history to modern progress in about seventeen days, not cost over eighty-four dollars, and begin paying dividends in about four weeks. It takes time to run a place down, said time depending on circumstances, the firm, the boss and more circumstances; and it takes time and a half to build it up, which some seem to forget. Joe had always been a good boy, and the superintendent, Mr. B., liked him, as was proper, and Joe went to Mr. B. and asked for some advice in the matter, and as they were near my bench I overheard most of it, and 'twas good, too, and if every new foreman or "super" had heard and would follow it, there'd be fewer failures and fizzles in shop management. "Joe," he said, "I'm no model nor no Century Dictionary, but I'll tell you, you'll find some things that will make you wish you were back here; but go and do your best and and you'll win in the end, but stick to it and don't give up when even the firm seem agin you, for they will be a dozen times the first month, till you make them see you are right, and in order to do this you must *keep right*. The great stumbling block of foremen and managers of any kind, young or old, is in making changes, some seeming to think that they must change things or they are not doing anything to show their knowledge. *Don't make any changes unless you are sure they will be beneficial*, for changes for the sake of change are usually worse than useless; they are expensive and they cause a loss of confidence in the new manager. The old men of the shop naturally distrust a new foreman, especially a young man and an outsider, and they are not apt to help him very much until he gains their confidence, and indiscriminate changes are usually sized up as an attempt to show a newly acquired authority, which it usually is. Let me repeat, don't make a change until you are reasonably sure it will be an improvement. Don't jump at conclusions regarding the causes of poor work; examine closely and find the reason for a machine's poor performance; it is often the men and not the machine, and you are mechanic enough to know this if you go slow and are not tempted into hasty conclusions and opinions. Better let a machine stand idle a few minutes while you think it over, but of course learn to think quick. Look over a tool well before condemning it, but when you once decide it is unfit for the work, lose no time in finding a substitute; prompt action increases confidence. If you cannot get a new machine and can alter an old one so as to do fairly well, do so, but put yourself on record for the new machine, and pave the way for it as easily and quickly as possible. When good work cannot be produced by the tools you have in a reasonable time, lose no time in making this known and let your demands be firm, urgent and repeated, until it has the desired effect, as delay is not only losing money for the firm, but is hurting your reputation for securing economical production. When you feel inclined to show favoritism to some man you used to know, or your wife's second cousin's sister's husband,—don't, it's a dangerous practice, even if some seem to deserve better treatment than others, but give the work to the best men regardless of anything else. There's another plan I'd recommend you to study and put into practice if you can, and that's the so-called premium plan, which consists of dividing any saving effected between the men and the firm. After careful study you set a 'time' for each piece of work you can; if that time is shortened the saving in wages is divided between the man or men and the company. It can be worked in a great many ways, Joe, and it will pay you to look into it. Good luck, Joe, my boy; I see they want me in the office;" and he was off, but I've thinking it over since, and I think it's about as sensible advice as I've heard or seen anywhere. But Mr. B. is a sensible man and has lived pretty close to the advice he gave Joe, and his experience, which was the subject of my last paper, has probably helped him. And as he brought the company out of the slough of alleged reform into which it was plunged, he proves pretty well that what he said will work in practice.

SOME HARTFORD NOTES.

A circle with a radius of little more than a hundred miles, and having for its centre the city of Hartford, will include the cities of New York, Boston, Worcester, Providence, Springfield, Waterbury, Bridgeport, New Britain, Meriden, and innumerable small manufacturing towns in those portions of Massachusetts and Connecticut which produce three-fourths of the lighter articles made from metal in this country. Nowhere is the improvement in business so plainly visible as in Hartford ; every shop is running to its full capacity—some on double time; and over 7,500 men, by careful computation, are busy making dollars for themselves and their employers in that city. 2,400 of these are turning out Columbia bicycles at the Pope shops; about 1,000 are occupied on Pratt & Whitney's varied line, an equal number at the several shops at Colt's Armory, and smaller numbers at various shops throughout the city, in the production of drop forgings, sensitive drills, chucks, machine screws, valves, printing presses, and a multitude of articles which may be classed under the general heading of light machinery. Manufactories of similar character "flock together" much as birds do; one town running to bells like Easthampton; another to brass goods like Waterbury; another to hardware like New Britain. Hartford runs to light machinery, nothing that can be called "heavy," to the writer's knowledge, being made in the city, with the possible exception of Billings & Spencer's drop hammers and Pratt & Whitney's milling machines.



SOME HARTFOR

Quite a percentage of the product of the Hartford shops is turned out by piece work. In some of the shops it is given in portions to contractors who hire their own men, and are in a measure independent employers. The positions are usually exceedingly profitable, one Hartford contractor having made a round $5,000 in twelve months during the hard times of 1893-4. During Sam Colt's flush period, a young mechanic who was fortunate enough to secure the Colonel's favor, was credited with having cleared $35,000 in four years.

Piece work is the cause of much hard thinking by both employee and employer. It is almost impossible to tell exactly what the labor in a new piece of work is worth, and the superintendent or foreman usually fixes a price by comparison with a previous piece of similar character, using of course his judgment as to the time required to do the work. If the mechanic makes too much money at this valuation, the price is quickly reduced and he resolves in future to "nurse his job" better. Fame, if not fortune, awaits the man who invents a satisfactory solution of this problem.

Nearly all the Hartford machine shops are built along Capitol Avenue, close to the railroad, and not far from the beautiful structure which shelters the State Government, notable for being the only "State House" ever built for less than the appropriation. Of late years new buildings have constantly been going up in this section, among others the Columbia people having added largely to their old shop, which was originally the Weed Sewing Machine Company's factory, and last year they completed a handsome office building into which the general offices were removed from Boston.

In strange contrast to the air of newness and progress which distinguishes the Capitol Avenue section, are the old-fashioned and neglected-looking buildings of the Colt's Armory, a cluster of shops about a mile southeast of the Capitol, which shelter nearly a thousand mechanics employed on the work that the Colt's Company do by contract, as well as their own firearms business. The site is admirably chosen for a plant of this character, being not only close to the main waterway of the State, but also on a branch of the "Consolidated" railroad. Colt died in 1861 at the early age of 48, worn out by hard work, leaving a great fortune and the foundation of an immense business which has made little progress since his death. Colt was one of the most original and picturesque figures of his time, a man of tremendous energy and unusual business ability, but not much of a mechanic. A well-known manufacturer who knew him well, says that if Colt had lived the allotted time, his Armory would have been the largest work-shop of its kind in the world. Assuredly the industrial topography of Hartford would, in that event, have been vastly different from what it is to-day.

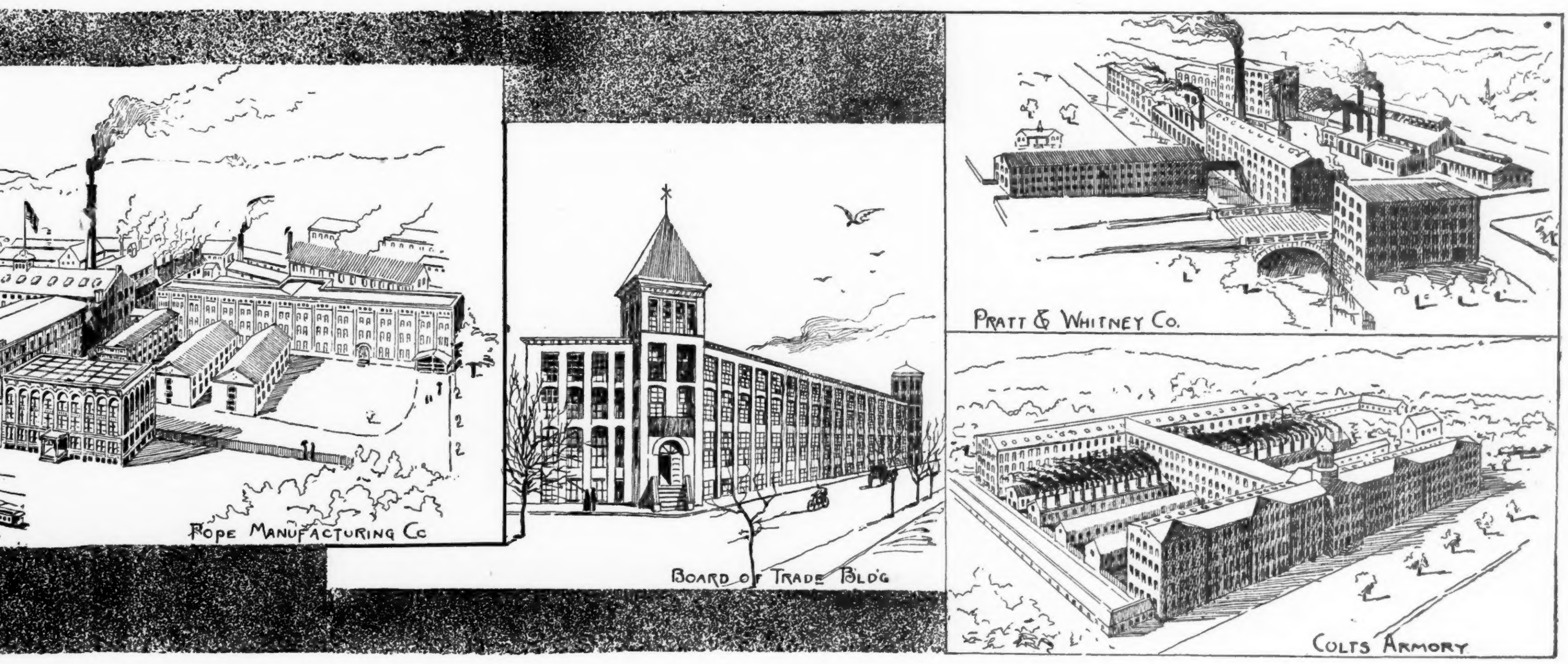
* * *

SOMETHING ABOUT "STARTING UP" NEW PLANTS.

Wm. O. Webber.

STARTING FIRES, ETC.

Before doing anything else, see that your boiler is properly filled with water, at least up to the second or middle gauge-cock, and preferably between that and the third; but do not have the water above this point, as it will expand by becoming hot and the water line will rise nearly an inch when the water begins to make steam, and you will be likely to carry water over into your engine on starting up, especially if the boiler is dirty inside and has not been blown out thoroughly when it was tested. A very good plan is to get up, say, about five pounds pressure, then draw your fires and blow out your boiler by the blow off cock at the back and bottom of boiler, opening the try-cocks as soon as the gauge shows little or no pressure, so as to admitair to take the place of the steam and water blown off. Then start again as before. In filling the boiler open the try-cocks wide open, also any valves



ARTFORD SHOPS.

which may be on the highest part of the boiler, such as the safety valve, to allow the air in the boiler to escape, as it is displaced by the water. The boiler being filled as described, try all of the cocks on the water-column, those on top and bottom of glass as well as the try-cocks, to be sure that they are not stuck or choked up; then close them all carefully. In starting a new boiler it is wiser to unscrew the steam gauge and *know* that the loop or syphon is full of water, as hot steam coming in direct contact with the "Bourdon" tube in a gauge will ruin it.

Now see that your grate-bars are in properly, resting easily on their bearer bars, and fronts move about a quarter of an inch at least "fore and aft," so that they will not cramp and bend out of shape when they have expanded by becoming nearly red hot, and also having a little motion sideways. Build a fire of oily waste, shavings and dry wood and light it, but do not put on any coal until you have a good hot wood fire and bed of red hot coals. A new boiler usually does not draw well at first or until it gets thoroughly heated up, and a wood fire is much quicker for this than the coal.

Now put your coal on and when you have your coal fire well going and from ten to fifteen pounds of steam, try your valves again and also your safety-valve lever to see that it does not stick. Repeat this again when you have your full pressure of from 80 to 100 pounds, so that you *know* that all of the valves and cocks under your charge will work freely and not be cramped at either full pressure or little or no pressure; then you can feel safe and go ahead.

Now look to the *pumps* under your charge. See that your boiler-feed pump is properly piped and that you *know* that the suction and discharge pipes are free and open, and that the check-valve, for instance, has not been put in wrong side about. Then having packed the piston-rods and valve steam glands, put the lubricator on and having filled it with cylinder oil, opening the feed valves to admit oil to the steam chest of pump, you are ready to make a start, which must be first done by opening the drip-cocks on steam cylinders and slowly admitting steam by opening the throttle-valve in steam pipe from the boiler a little way, say about a quarter turn, letting the steam cylinder warm up slowly before going to work. After the pump has started properly let it run a few moments and it will soon displace the air in itself and pipes, and water will appear at the pet cock, which should be left open up to this time.

A packed plunger or piston pattern pump may sometimes refuse to start promptly because of the packing having swelled, thereby binding the piston in pump cylinder. A sharp blow on the flange of the water cylinder with a hammer will generally jar the piston loose, and the pump will start. If, however, this is not sufficient, it may be necessary to take off the heads of the water cylinders and slacken up the check-nuts on the ends of piston-rods, and then start the pistons along by driving on the ends of rods with a wooden block and hammer.

Do not screw the stuffing glands on valve-stems and piston-rods up too tight. When they require to be screwed up very tight in order to prevent leaking, they need repacking. A stuffing-box should always be kept full of packing screwed up with only a moderate tension, instead of nearly empty and screwed up *very* tight. This packing should be well greased in the first place, preferably with a heavy grease, like tallow, and a drop of oil should be put on the rods and stems every hour or so. The pump drawing and forcing water readily, as shown from the stream from the pet cock, the check-valve working properly, the water should rise rapidly in the boiler.

On stopping a pump at night always open the drip-cocks on the steam cylinders, and if the pump is in an exposed position liable to freeze up at night, open those on the water cylinders also, then close the valves on cylinder lubricator.

These same remarks will apply to starting your engine, only if you are using automatic oiling devices you must *know* that they are feeding properly or that the oil is going to the right place. Always start your engine slowly and let it run so a few minutes to get warmed up, and do not close the cylinder cocks until the engine has been running up to speed for at least a couple of minutes. A new engine must always be watched carefully, and it is much better to let it pound somewhat and make more or less noise for a day or so, than to key it up so tight in the effort to prevent this, as to cause it to run hot and perhaps melt out the main bearings or the crank-pin boxes. After the engine has run a day or so and runs perfectly cool, then key it up gradually until all pounding ceases and the engine runs cool and smooth. If this does not take place in the course of two or three days, either your lubricating oils are worthless or else your engine has not been set up properly and is out of line. A very frequent cause of engines heating is in not properly "shiming" up under the bed, so as to make it rest freely on the foundation, and then running cement or lead under the edge of bed, but in putting the engine down on a surface that is not absolutely true and then drawing the bed down to this uneven surface, thereby cramping the bed and drawing the engine out of line and truth.

Try to keep up the small repairs on your own engine and when any larger repairs are necessary stay around and help the men making them even if you do nothing more than hold a lamp for them. You will learn more about an engine in this way than by running one for a year, if you are a willing "helper", and it is an unusually surly repair man who will not be willing to

answer your questions and give you some good advice and "points" also. Do this work for nothing and say nothing about extra pay. Get on the right side of the repair man and you will, at the same, time be getting on the right side of your employer.

Do not let the water in your boiler ever get out of sight in your gauge glass or below the lower gauge cock; if it does and *you do not know* at what level the water is in your boiler, *draw your fire instantly* and open the two upper gauge cocks and leave them open; do not attempt to pump any more water into the boiler under any circumstances until the supply valve has ceased blowing off and you *know* that the steam pressure is falling by the gauge, then fill the boiler as before to midway of middle and upper gauge cocks.

Be careful about keeping ashes well cleaned out of ash-pit under the boiler; a set of grates will never "burn out" with an empty ash-pit.

Don't pump greasy water into your boiler.

Always try your safety-valve at least once a week to *know* that it is not stuck fast to its seat.

Wash out your boiler at least once a month and blow off at one-fifth pressure, through blow-off cock.

Do not let your boiler get full of scale around the "mud ring."

Keep your boiler clean by giving it about a quart of kerosene oil pumped in with the feed water about once a week. An oil receiver can be made of a piece of 4-inch pipe, with a valve top and bottom. Shut lower valve, fill with kerosene, shut upper valve, open lower one and pump oil in with the water.

* * *

PRACTICAL PROBLEMS.

JOHN T. USHER.

In the ordinary routine of machine shop work there is very little chance for the development of that inherent inventive faculty possessed by the most intelligent machinists, and many a bright mind is compelled to remain in a state of inactivity, with its possessor in oblivion, simply because there is no opportunity to show what he is capable of doing.

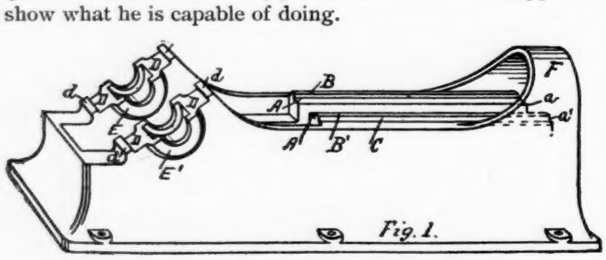


Fig. 1.

To a certain extent the draftsman and tool-maker can find material upon which they can exercise their inventive talents, but even here the problems to be solved are, as it were, always restricted to the particular line of work upon which they happen to be engaged, and which of itself may not call for, or admit of, an inventive capacity of a very high order. In fact, it is doubtful if they can find in this manner such material as would tax their ability to any great extent, and hence if either the machinist, draftsman or tool-maker is desirous of cultivating the inventive faculty in order to attain a higher standard in that direction, they must in most cases seek for material outside of their own line, or otherwise make a radical departure from the ordinary practice in that line, before they can attain any prominence.

I do not know of any better means of cultivating the inventive faculty which is applicable to all engaged in machine shop work, than the method suggested and introduced in the *American Machinist* by Mr. Leicester Allen, and which is by far the most instructive and practical of any method that has ever come to my notice. This method consists of propounding a constructive problem, the solution of which calls for the invention of any mechanism that will accomplish the movement or movements desired, and in presenting the problem for solution excluding most of the ordinary mechanical movements such as would be likely to occur to the mind of the designer on first thought, which compels the participants to devise or invent entirely new and original motions. Many of the solutions of the above problems have been remarkable for their simplicity and efficiency, and display a faculty for inventing of the very highest order, such indeed as have seldom been excelled or even equalled.

It is proposed in these articles to present a series of problems for solution, in a similar manner to the above, but to let the problems represent examples of machine shop work, instead of constructive problems, thereby admitting of the mind being trained upon subjects pertaining to the machinists' own specialty, and which it is thought will be more directly in line with the requirements of every-day practice.

The first problem given for solution, and which will be known as problem No. 1, shown in Fig. 1, represents the bed of a center-crank horizontal engine, the guides A A′ forming a part of the bed itself.

In nearly all engine beds of this type the guides extend to a greater or lesser extent into that part of the bed covered by the hood F, and consequently the part of the guides that are covered by the hood is always difficult of access in planing (by which method the guides are always machined), owing to the distance the point of the planer tool must stand in advance of its body, and which seldom admits of the job being done as satisfactorily as could be desired.

Owing to the peculiar position of the guides no attempt has (as far as can be ascertained) been made to machine them by milling; in fact, as at present constructed, the milling machine is not at all adapted for this purpose.

PROBLEM NO. 1.

The requirements of this problem call for a device by means of which the guides A A′ (Fig. 1), including the flange and fillet B B′ C, can be milled at one operation. This operation is perfectly feasible, but could be better performed on a planer, or on a milling machine constructed on the same lines, though any device applicable to other types of machines will be considered on an equal basis.

The only restrictions on the solution of this problem is that the device must be so arranged that it can be slid out of the way, or readily removed, to admit of the application of a second (or of a second and a third) device for milling off the ends E E′ and inclined surfaces D D D D and flanges *d d d d* of the pillow-blocks (bearings) at the same setting of the bed on the machine. The application of milling cutters to the latter purpose furnishes problem No. 2, which, to avoid confusion, will be specified separately.

PROBLEM NO. 2.

Problem No. 2 calls for one or two devices by means of which the ends E E′, inclined surfaces D D D D and flanges *d d d d* of the pillow-blocks (bearings) of the same engine bed (shown in Fig. 1) can be milled at one or two operations.

It should be remembered that the space between the guides A A′ and the hood F seldom exceeds one inch, which will affect the solution of problem No. 1 to some extent.

The diameter of cutter employed in milling the ends of bearings must not exceed the diameter of the bosses E E′ by more than one inch; *i. e.*, the device must admit of this diameter being employed.

[Solutions can be sent to the Editor of MACHINERY for either one or both problems, but he reserves the right to reject any that are not considered efficient for the purpose.

To enable those to participate who are fully competent to offer satisfactory solutions to the above problems, but may not be able to make finished drawings of their solutions, we will undertake to develop the drawings for publication, provided the drawings or sketches of the devices are sufficiently accurate to clearly represent the solution of the problem.—ED.]

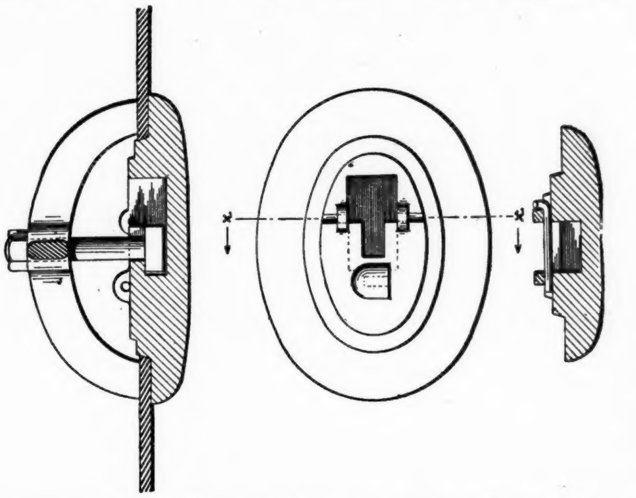
* * *

IMPROVED HAND-HOLE PLATES.

All who are familiar with boilers know the annoyance and danger of having the stud in the hand-hole plate break, or of finding the nut corroded fast so that it is impossible to move it without breaking the bolt. The stud, as usually made, goes through the plate and is riveted over, the rivet-head on one side and a collar on the other, being supposed to make a steam-tight joint. The extreme heat to which the stud is subjected crystallizes the metal and makes it brittle, which accounts for the numerous breakages which occur when an attendant attempts to tighten a joint which is leaking a little. The danger of this when the boiler is full or under pressure, is well known to engineers and firemen.

The improvement of Messrs. Eugene C. Myrick and George C. Doeg does away with the stud which goes through the plate and uses an ordinary headed bolt instead, the head of which is inserted into the slot and is retained by the lips. The method of applying this form of hand-hole plate is very similar to the usual kind, as aside from the difference between the bolt and stud the

action is the same, the ordinary frog (or frame) and nut being used. In case of breakage, the head can be easily removed and a new one substiuted. To prevent the bolt accidentally working sideways a sufficient distance to free the head from the lips, the pin is "slipped" through the lugs, as shown in Fig. 3. Arrangements are also made so that in case a bolt breaks while the boiler is in service, the plate may be securely held by a suitable hook or holding device, inserted through a hole in an ear provided for



that purpose. This allows a single workman to replace a broken bolt without throwing the boiler out of service. In case of corrosion of nut so as to prevent its being unscrewed, the frog and bolt may be driven sideways together until the head is released. These and other advantages will be apparent to the engineer or fireman, and those interested should address Mr. E. C. Myrick, Silver Spring Bleaching & Dyeing Co., Providence, R. I.

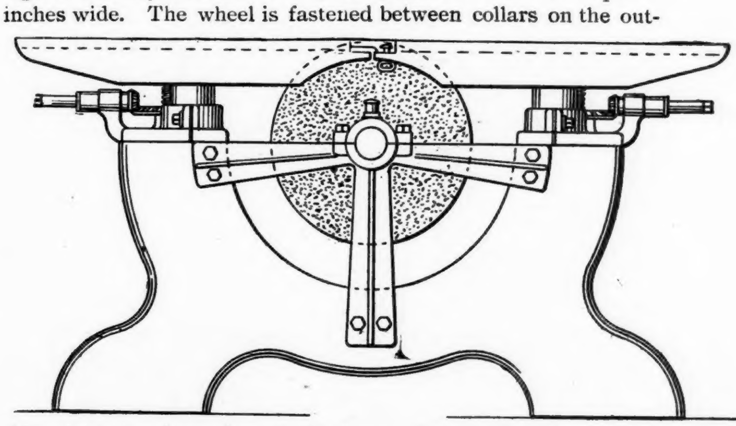
* * *

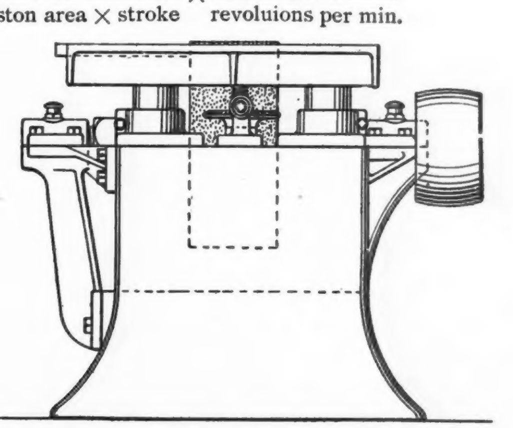
A SURFACE GRINDING AND POLISHING MACHINE.

This is made by the Diamond Machine Co., of Providence, R. I., and is designed to grind and polish surfaces of different widths.

The illustration shows the platen with the ribbed surface carefully ground, and placed above the wheel. The platen is webbed on the under side and supported on strong columns. It is cut across in the center on a line with the axis of the wheel, and each part may be raised or lowered independently by means of a pair of bevel gears actuated by a crank. This device enables the operator to move the tables rapidly, and at the same time allows a very delicate adjustment, which is necessary when only a slight portion of the work is to be removed. The tables may be clamped securely at any point by means of split sleeves. These separately adjustable tables obviate any irregularities in the finished surface, as the receiving table takes the work at the proper height and prevents any rocking motion. It also relieves the spindle of any unnecessary weight.

A throat piece is let into the table flush with the top, and can be adjusted to conform to any width of wheel. The machine is designed to carry wheels from 14 to 24 inches in diameter up to 8 inches wide. The wheel is fastened between collars on the out-





side of the bearings close to the boxes, the latter having a very long bearing surface with large diameters. The bearings are constructed with patent dust protectors to exclude the emery dust. The spindles and boxes are built in a most substantial manner. In order to accommodate wider wheels, provision is made for placing a spider frame on the outside of the machine as shown in the detail drawing. Wheels 18 inches wide are used by this arrangement, which may be attached to any standard machine. Leather covered or walrus covered polishing wheels, or emery wheels are used.

The machine occupies a floor space 36 by 58 inches; the height from floor to the top of the table when lowered is 31 inches; the distance from floor to top of table when raised to extreme height 36 inches. The table is 28 by 64; the pulley on the spindle 10 inches diameter, six inch face; the bearing on the boxes 2¾ inches diameter 7 inches long. The diameter of the spindle between flanges is 2½ inches.

* * *

A HANDY PLANIMETER.

We present in accompanying engravings a planimeter which besides reading areas and mean effective pressure, is we believe the first to read horse power without necessitating calculation.

The wheel of this instrument, as will be seen in illustration, both slides and rolls upon its axis. The triangular scale has six differently graduated edges, any of which can be turned next the wheel, and the amount of the sliding movement of the wheel thus measured in the unit suited to the work. If the points A and B be clamped six inches apart and the 60 scale turned next the wheel, the instrument reads square inches, or by proper selection of scale and dis-

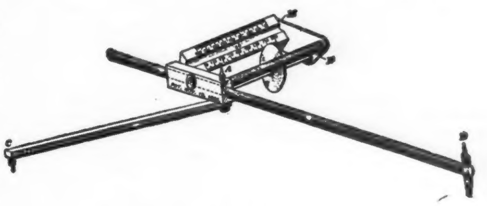


FIG. 1.

tance apart for A and B it will read in any desired unit. If the points A and B be set to card length and the scale turned next the wheel which corresponds to the spring with which the indicator card is taken, the instrument reads mean effective pressure, for the reading = scale × wheel movement = scale × area ÷ length of A B = spring × card area ÷ card length = M. E. P.

To read horse-power, lines p and q (Fig. 2) are set to the divisions corresponding to the revolutions per minute of the engine; points G and H are set to card length (as per Fig. 2) and the points A and B are set to the value of 33,000 ÷ piston area × stroke, as given by tables accompanying the instrument. On removing the attachment from the card and going over

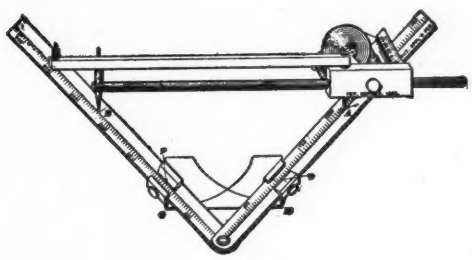


FIG. 2.

the card with the planimeter, it will read horse power. For by similar triangles (Fig. 2) A B = O A × G H ÷ $o\,q$

$$= \frac{33{,}000}{\text{Piston area} \times \text{stroke}} \times \frac{\text{card length}}{\text{revoluions per min.}}$$

The reading = scale × area ÷ A B = spring × card area ÷ the above value of A B, or we have reading =

$$\frac{\text{Spring} \times \text{card area}}{\text{card length}} \times \frac{\text{Piston area} \times \text{stroke} \times \text{rev. per min.}}{33{,}000} =$$

M. E. P × constant of engine = horse power.

Full particulars of this instrument can be had from Mr. Edward J. Willis, 200 East Franklin Street, Richmond, Virginia.

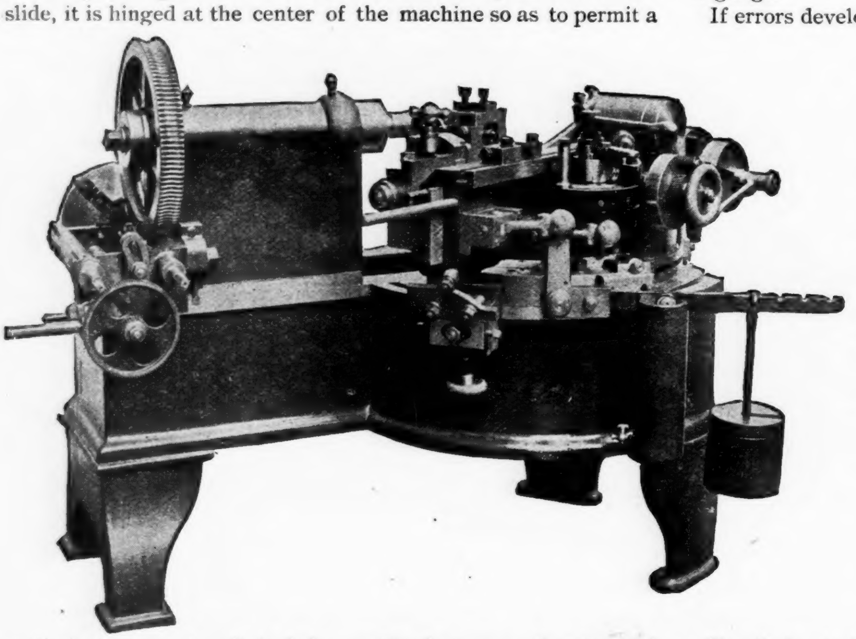
* * *

A NEW BEVEL GEAR PLANER.

This is the first published illustration of an automatic bevel gear planer, on which foreign and American patents were issued to the Gleason Tool Co., Rochester, N. Y., in April, 1894.

The gear to be planed is mounted on a spindle carried in the head of the machine, and the machine is moved back or forward like the tail-stock of a lathe till the bevel gear it carries is in such position that the apex of its cone lines is at the center of machine.

The slide on which the tool-holder travels is rotated at the center of the machine so that it can be moved in line with the pitch line angle of gear. Beside this horizontal adjustment of the slide, it is hinged at the center of the machine so as to permit a



vertical adjustment as it is fed over the former, so that the tool always travels on the correct angle of the gear from the top of tooth to the root, and the tooth therefore has the perfect reducing cut, and the small end is in proportion to the large end.

The formers which give curve to the teeth are made very accurately. The master formers have been laid out with great care on a pitch circle several times larger than any gear to be planed, so that any possible inaccuracy in the former is reduced to a minimum in the gear. The formers which are furnished with the planers are made on a profile machine, so that they are exact duplicates of these master formers.

For indexing, the first stop is adjusted so as to throw the feed out automatically when the tool has fed to the proper depth. The gear is indexed automatically and the second stop throws the feed in again.

The machine is very simple of adjustment, and it requires no more skill to operate it than for an automatic rotary gear cutter.

* * *

The illustrations of the three jigs in our August issue should have been credited to their designer, Mr. Warren E. Willis of Providence, R. I.

* * *

ABOUT ORDERING WORK.

The cost of work largely depends on how it is placed in our hands. Clear and detailed orders can be promptly and economically carried out, while vague directions generally result in excessive cost, and loss of time.

We cannot too strongly urge our customers to either make, or have us make, detailed working drawings before we are asked to bid on work.

We cannot undertake work without drawings, unless it is of the simplest kind.

The drawing board is a cheap place to experiment on. All points cannot be determined on paper, but we are safe in saying that what costs one cent to draw, will cost one dollar to dig out of the solid in the shop.

There is this advantage in having us make detailed drawings, namely, that we can make them conform to our system of manufacture, thereby avoiding much confusion and greatly expediting work.

When working from drawings sent us, we will be guided by figures only. We do not allow our men to put their scale on a drawing.

We guarantee the workmanship to be first-class in every way, and if we furnish the material it will be the best of its kind; but under no circumstances will we guarantee the satisfactory working of any mechanical device, unless by special bargain.

If flaws develop in material sent us to finish, making our work useless, we charge the cost of bringing the new material to the state of finish of the abandoned piece, at day's work prices.

All measurements are supposed to be in inches and fractions thereof, unless otherwise specified, and we will use our judgment in absence of instructions as to how close the work is to be brought to gauge.

If errors develop in work due to drawings not made by us, we make such errors good at the expense of the customer, but use great care to point out errors in drawings and to avoid mistakes therefrom.

We study to economize for our customers by using standard screws, gears, shafts, pulleys, pins, etc., wherever possible.

We keep our standard gauges by close inspection, and have means for detecting minute errors.

A very small change in size or form of an article cannot usually be made without much greater expense than is at first sight apparent. Even altering a screw is likely to demand new jigs and gauges, and may create confusion and waste.

The cost of making a single article bears no proportion to that of making a large number. What costs dollars in one case may cost but a few cents in the other.

It is impossible, generally, to deliver part of a large order without adding greatly to the cost of those pieces first delivered, and delaying the final delivery of complete order.

To obtain steel or malleable iron castings, not less than twenty-one days must be allowed.

Cast iron in small quantities and of simple forms can be had in as short a space of time as twenty-four hours.

Brass can often be obtained in three hours, and one day generally is all that is required to get even large castings.

Forgings if not very large can be obtained in a few hours.

Odd gears are very expensive and require from two to three weeks to get out, as cutters have to be made. Special form milling cutters require about a week if not complicated.

Pattern work requires much time, and small pieces never should be gated if wanted in malleable iron or steel, as foundries prefer to do this themselves.

Drop forgings are only economical when wanted in large quantities, as it takes weeks to make dies and they are very expensive.

All jigs and special fixtures made for a job are charged for at the regular rates unless otherwise agreed.

Our shop is brick and of a slow burning class, and it stands fifty feet from other buildings.

We never insure work in progress unless directed so to do, and then only at the expense of our customers.

On experimental work, we render weekly statements and expect payment of same on the first of the following week.

We cannot take work from strangers without a deposit, and when this is exhausted we suspend operations until further funds are furnished.

We do not hold ourselves responsible for goods, once they leave our shop, except in so far as to see they are placed in responsible hands. *From catalog of W. D. Forbes & Co., Hoboken, N. J.*

* * *

Several inquiries regarding the article on Slide Valve Study by Mr. Robert Grimshaw, will be fully answered next month.

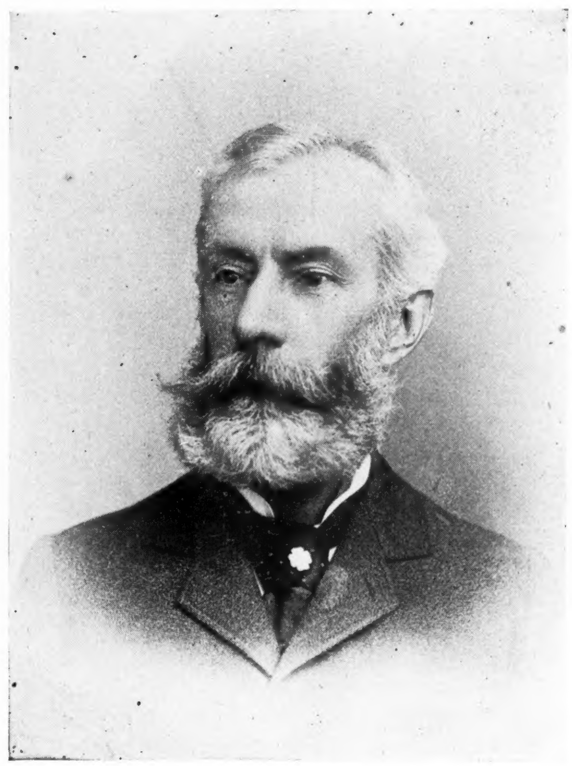
* * *

The best babbitt bearings are made by having a clean surface for the metal to adhere to, rough boring, compression (preferably by rolling) to fill out any shrinkage and make the metal more dense, after which it should be rebored and scraped to fit. It costs a little more but it pays for any bearing requiring high speed or great accuracy, or both.

E. F. C. DAVIS.

The many friends of the late President of the American Society of Mechanical Engineers were shocked to learn of his sudden death on August 6th, caused by being thrown and crushed by his spirited Kentucky mare. We reproduce his latest photograph, together with extracts of his life, written by his friend Mr. Angus Sinclair for the *Engineering News*, immediately after his election last December. At the time of his death he was manager of the C. W. Hunt Co., of New York.

Mr. E. F. C. Davis was born in 1847, at Chestertown, Md., a small village on the Eastern Peninsula. His family were of Welsh extraction, but had resided in Maryland for several generations. It was the settled purpose of Mr. Davis' parents that he should be a lawyer, the profession that his father and grandfather had followed; and with that in view he received a classical education, and was graduated from Washington College, Maryland, in 1866. From his earliest boyhood, Mr. Davis had shown a decided fondness for mechanical pursuits, and as he grew older his distaste for the profession became more pronounced.



E. F. C. Davis.

That an intelligent youth should prefer the hard and dirty manual labor involved in the choice of a mechanical life to the dignity and social standing which he might expect in following his father's profession, seemed a foolish and inexplicable whim to his parents and friends, and every possible means was taken to turn his attention from the direction which his natural tastes drew him. At that time mechanical engineering in this country was in its infancy, and for a youth of good family, fine education and excellent prospects to turn to mechanical pursuits did, indeed, seem veritable folly.

During the last months of his school life he devoted his leisure hours to making, with his own hands, a working model of an oscillating marine engine. The little engine worked perfectly, and showed such excellent workmanship that the youth's mechanical talents were reluctantly conceded by his friends, although they still opposed his adoption of the profession for which he was manifestly fitted. Finally, however, the boy's firm determination to become an engineer carried the day, and his parents sent him to Philadelphia to see if he could find an opening in some engineering establishment, thinking, no doubt, that a short experience of hard work and long hours would wean him from his fondness for mechanical pursuits.

He was about giving up hope of finding an opening when Mr. Henderson, a Scotch engineer of the old school, and a member of the firm of Brinton & Hend rson called at the house where Mr. Davis was staying, and was shown the working model. This excited his interest in the maker, and on being told that he wanted to learn the machinists' trade, Mr. Henderson invited him to enter the Hydraulic works of Brinton & Henderson as an apprentice, and proved a very good friend.

Mr. Davis left these works after the conclusion of his apprenticeship, a good machinist and a competent draftsman. He went from Philadelphia to New Castle, Del., and entered the employ of Hoy, Kennedy & Co. While with them he assisted in the transfer of their plant from New Castle to the Atlantic Dock Iron Works, South Brooklyn, N. Y., and had charge of arranging and fitting up the new machine shop. After the works were in running order he was engaged in making drawings for the Mutual Gas Works, which were built on the site of the old Novelty Iron Works, on East River, New York.

For several years he took a hand in all the kinds of engineering work that comes to a general engineering establishment, and then he left Brooklyn to accept a position as draftsman with the Pottsville Iron & Steel Co., a concern which was then doing business in a small way, and was just beginning to develop the machinery required for extended work. Here Mr. Davis obtained much valuable experience, first in effecting improvements upon the older forms of machinery, and afterwards in designing and erecting a new and improved plant for the company's works.

His next change was to the position of draftsman and assistant to Mr. S. B. Whiting, superintendent of the Colliery Iron Works, at Pottsville, Pa. These works made a specialty of the most improved and best types of machinery for coal mining. The coal mining machinery of Pennsylvania was much more crude at that day than at present, and there were excellent opportunities for an ingenious designer to make valuable improvements.

About this time the Philadelphia & Reading Coal & Iron Co. was formed, with great capital and influence behind it, and soon absorbed most of the anthracite collieries in the region about Pottsville. In 1878, Mr. Davis, who had won an excellent reputation by his work in Pottsville, entered the service of the company, as mechanical draftsman. A year later he was made superintendent of the company's shops at Pottsville, which were then being established for the purpose of building and repairing all the mining machinery required in the whole of the collieries operated by the company. In 1883 the Colliery Iron Works were added to this plant.

The work of organizing this large establishment fell principally upon Mr. Davis, who won much credit for the manner in which the work was done. In 1887 Mr. Davis was made mechanical engineer of the company, and had charge of all shops and machinery.

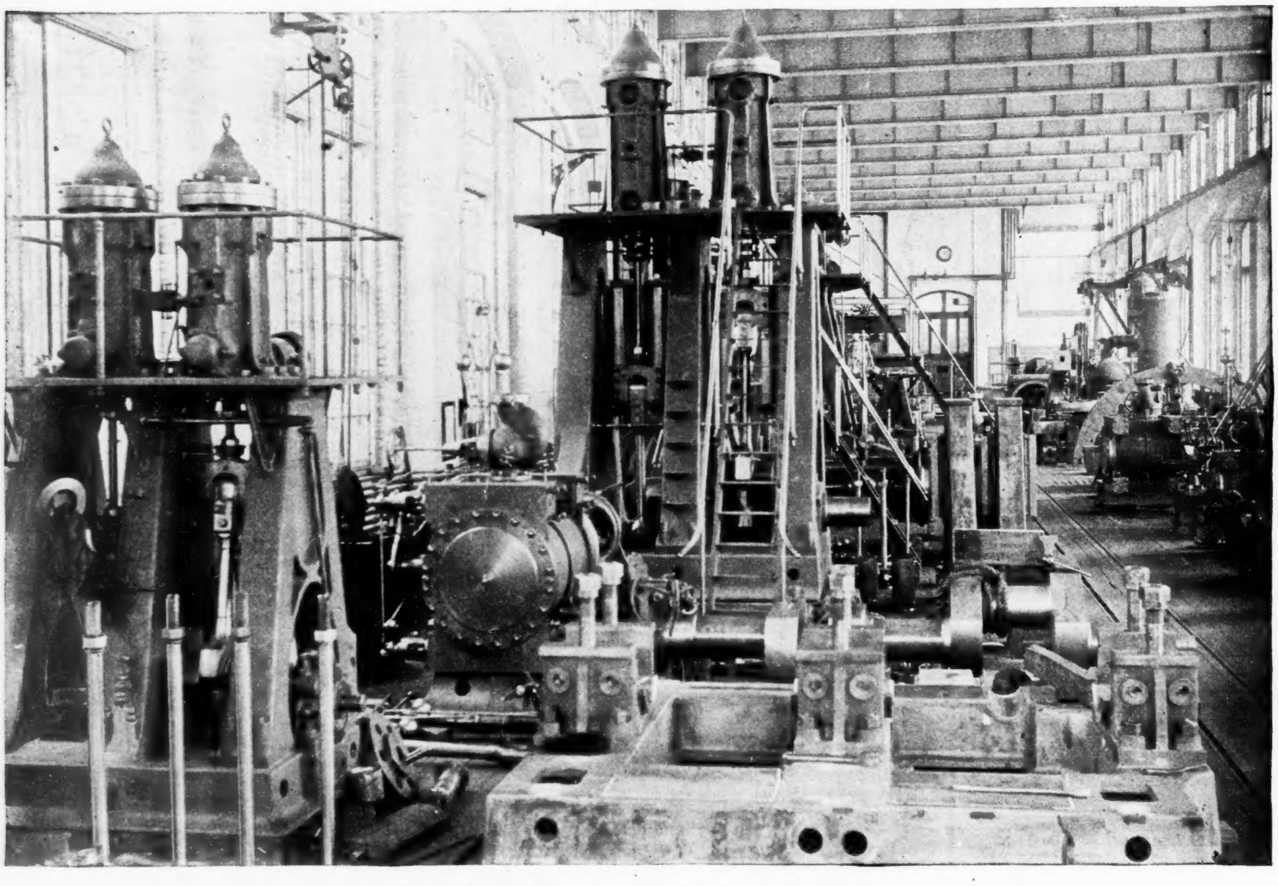
He remained in this position for three years, and in 1890 resigned to become general manager of the Richmond Locomotive & Machine Works. During his administration these works built the engines, boilers and machinery for the United States battleship *Texas*, and were developed from shops originally designed for building stationary and portable engines and saw mill machinery to a thoroughly modern and well equipped locomotive plant.

Mr. Davis was one of the earliest members of the American Society of Mechanical Engineers, joining the society in 1881, the year following its organization, and was a vice-president from 1891 to 1893. He was also a member of the American Railway Master Mechanics' Association. He made a special study of the subject of compound locomotives, and designed an engine of this type, which has shown excellent records. Mr. Davis was for many years an influential member of the Board of Managers of the Virginia Mechanics' Institute, of Richmond, and was chairman of the committee on night schools, which committee really has most of the work to do in connection with the management of the institute.

Mr. Davis' social characteristics won for him a large circle of friends. He was especially fond of entertaining at his home bright men interested in engineering works.

MODERN MACHINE SHOPS.

It is pleasant to note that modern shops are becoming more numerous and that there are many in various parts of the country which well deserve the name. The De La Vergne Refrigerating Co. is by no means a new concern, being among the pioneers in the field of artificial cooling and ice making, and their factory at the foot of East 138th street, New York City, contains much of interest to the mechanic. The buildings are well designed for the work in hand, and are better lighted than the majority of shops of this size, a fact which is appreciated by one who employs the camera to illustrate shops and methods, as does the writer. The offices and drawing rooms are interesting to those familiar with these departments of machine shop work and the danger of losses by fire is lessened by a fire-proof vault, lighted exclusively by electricity, where all drawings and tracings are kept. The blue-printing department of the drawing room is very interesting to a draftsman, and as four or more frames are kept in active service the importance of this department can be seen. This is not materially delayed by cloudy weather, as the room is equipped for printing by electric light when necessary. Before going into the shop it may be interesting to take a backward glance at the refrigerating or artificial cooling industry, which has of late years assumed such large proportions. As long ago as 1850-60 practical machines were produced which were in many respects similar to the most successful ones in use to-day; and in the year 1855 Prof. Twing, of New Haven, Conn., produced a compression machine in which ether was used, having a capacity of 1,600 pounds of ice per day of twenty-four hours. It was then, not the lack of a proper machine which prevented its introduction, but the want of a suitable application for it; as artificial ice-making on a commercial scale was not to be thought of at that time. What really hastened the development of refrigerating machinery was, despite the horrors of our prohibitionist friends, the lager beer breweries whose immense ice houses were a constant expense, to say nothing of the cost of handling the ice. Ice-making was not at first attempted, nor was it desirable for this purpose, but the cellars and vaults were to be maintained at a low temperature without the annoyance or expense of actually making ice. Slaughter houses, beef and pork packers and cold storage houses came next, and it required two mild winters from 1888 to 1890 to really give the ice business its start in a commercial way. But enough of history. The boiler room has six Manning boilers, and two good-sized engines are found in the power house, a small refrigerating plant being also in operation for the enlightenment of visitors and prospective buyers. Entering the erecting room, which is 55 by 275 feet, one finds a splendidly lighted room, as will be seen from the view shown, which is looking east, and was taken from the platform of an elevator at an elevation of perhaps eight feet from the floor. Several large refrigerating machines are shown in various stages of completion, from the bare bed-plate in the foreground, to those with the steps in position for reaching the upper or compressor cylinders shown farther back. A 15-ton traveling crane with 5½ feet span (electric, of course) handles any material that may be required anywhere in the shop, and has a speed of about 380 feet per minute. It is not shown, however, as it happened to be at the extreme end of the shop, over the camera. The walls and ceilings are white, and this adds much to the light, either by day or night, as the electric light can be much better distributed than where the walls are dark and refuse to reflect the light thrown on them. The arc lamps are hung on swinging arms, as can be seen on close inspection, which are so arranged as to be swung out of the way by the hoisting chain of the traveling crane should it chance to be at the end of the traveling span, and after it has passed, the arm and lamp swing back into position without damage to either, thus avoiding a constant lookout on the part of the crane-man, and an accident should he fail to see a lamp in time to stop. It may be interesting to engineers to note that this firm does not use an eccentric to obtain its valve motion, but a small crank-pin in the end of the main shaft drives the Corliss valves and prevents "monkeying" with the eccentric. They also connect what is commonly known as the "hook-rod" permanently to the wrist-plate, so as to prevent working the valves by hand, without moving the engine; this being the result of years of experience, and is said to be the simplest and best for this class of an engine.

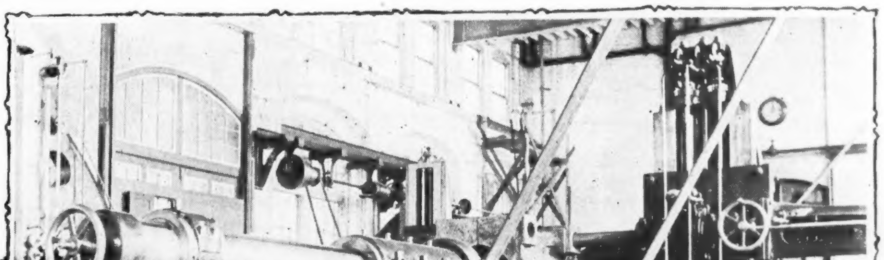
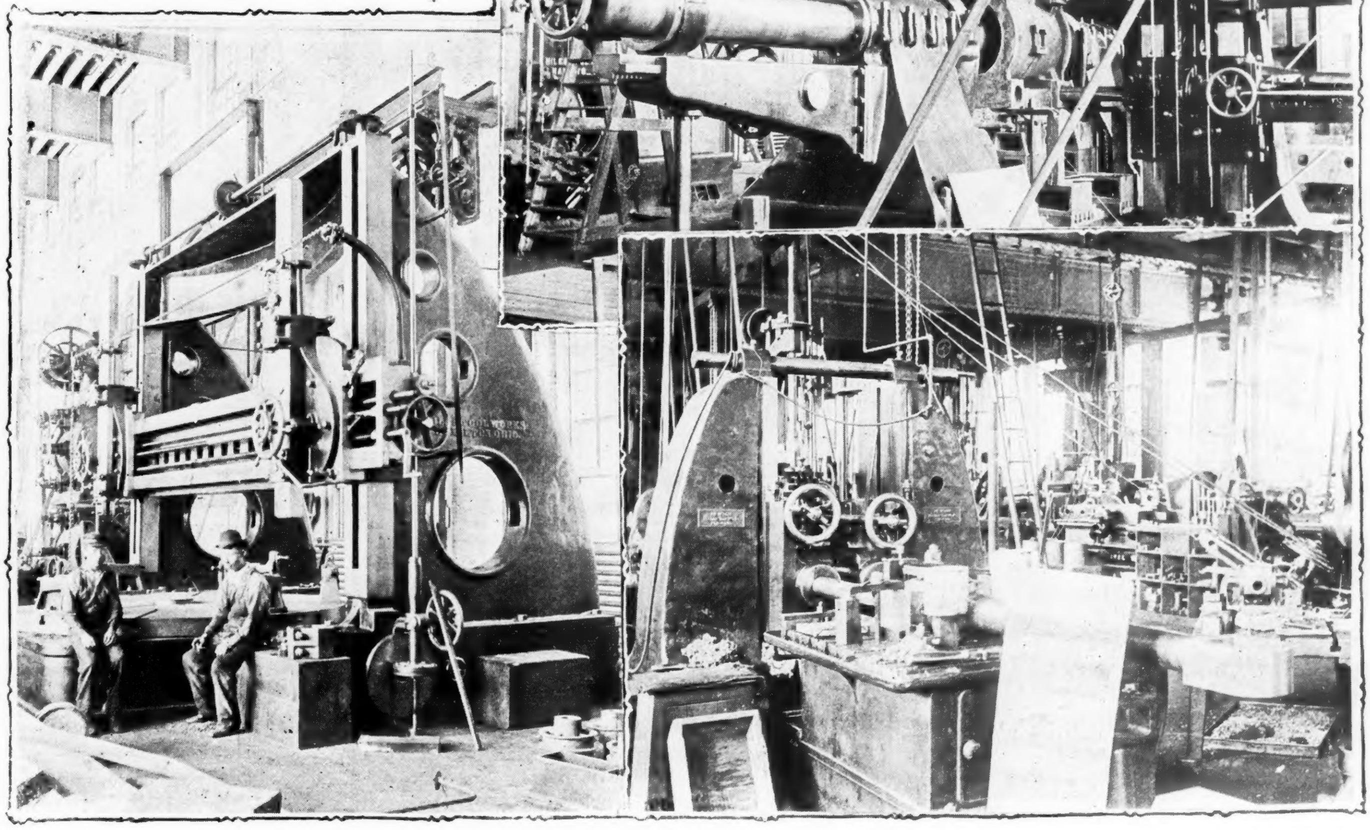


IN THE ERECTING SHOP—DE LA VERGNE REFRIGERATING CO.

Further down the shop is a large 54-inch boring mill, made by the Niles Tool Works, a view of which is shown in the group of tools on page 23. Its mode of operation is readily seen from the photograph, and the rigid supports for all the boring bars are in marked contrast to the weak-kneed and "wobbly" arrangements too often seen in shops whose economy consists of the failure to purchase suitable machinery. The 15-foot boring mill, by the

same makers, is a heavy tool, capable of turning out large quantities of work. As a means of comparison, the two apprentices volunteered to pose as yard-sticks, one even suspending operations on his favorite "corn-cob" during the agony of "being took." There are other large tools in place, a 30-foot planer and a 72-inch lathe being among the number. Each tool is run independently by a C. & C. motor, which is carefully protected by a sheet-iron cover to exclude dirt and to avoid accidental contacts. This was introduced by the late E. V. Clemens when superintendent of the plant, and has been entirely satisfactory. The absence of long lines of shafting and its attendant friction and care (which is too often *not* bestowed) and the advantage of being able to run any tool independent of the others, are features which are worth considering. With the stopping of the machine, the consumption of power practically ceases, the portion of the friction of engine and dynamo, which can be charged to each tool, being extremely small, and when running over-time the expense of running long lines of shafting to operate one tool is avoided.

At the west end of the erecting shop is a space 50 by 50 feet square which can be uncovered, revealing a pit eight feet deep; in this is a very heavy foundation, where the *500 ton refrigerating machines are erected, and as these weigh in the neighborhood of 175 tons, the need of a solid foundation is readily seen. The connecting-rods and similar work are made in the light machinery department, and here was found a double-headed boring mill made by the Newton Machine Co., of Philadelphia, which is not usually seen. The rods are of the marine type, and the ends require boring for the bolts, which hold the straps or end pieces in place, and in this machine the boring heads are adjusted to the right position and the boring is quickly and accurately done. The uprights are adjustable sideways and the boring heads can be moved vertically, allowing quite a range of work to be executed on this one machine. The square white object at the front of the machine is a blue-print fastened to a board, and these show in some other views as well, showing that the work is all done by following drawings, as must be the case where accurate and economical production is desired. Special tools and appliances abound, and but few of these can be shown, as time and lack of space forbid. One of these is the milling machine shown in connection with a large Brainard machine on page 24, the lower one showing a special form of machine for milling the ends of pipe supports, which are required to be faced smoothly and be of exact length. The supports are fastened to the octagonal frame of the machine, each side holding a pair, and as this revolves both ends are milled by cutters at each end, one of which can be partially seen in the the foreground. These are independently driven and are well supported, insuring a steady cut and satisfactory results. The Brainard machine is of a type not usually seen, and is very solidly built, being evidently designed for long surfacing work. The milling cutter is lubricated by flowing the lubricant into the V-shaped pan over the mill, and allowing it to trickle out through the perforations and on to the cutter and work. The pipe department is very interesting, as it really includes all the fittings, as well as the pipe itself, and these fittings are the result of much study and experiment. All female fittings have annular recess outside the thread, which are tinned for soldering, and all pipe has an inch band ground on it just above the thread, also tinned, so that when it is screwed in place the band comes within the recess, and filling with solder, a joint is made which must either stand the test of a thousand pounds per square inch or be rejected. Any defective pipe is effectually labelled by driving a chisel into it, avoiding any possibility of standing a second test.

THREE HEAVY TOOLS—DE LA VERGNE REFRIGERATING CO.

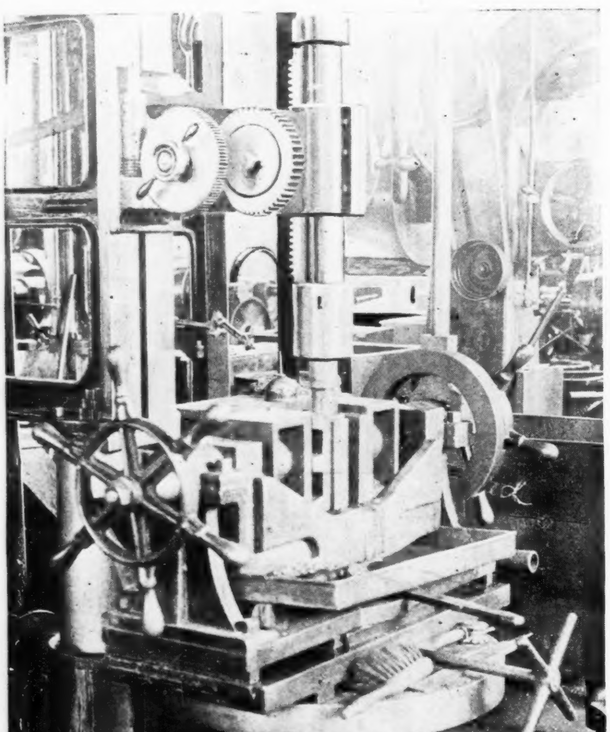
One of the many fixtures used in making fittings is shown in the photograph on page 24. This consists of a long body, shaped something like the cross-section of a piece of channel iron, mounted on trunnions at each end. In this are jaws for holding fittings, elbows in this case, the jaws being controlled by the hand wheels at each end. The lever shown forms the index as well as the means for turning the work into position. A careful observation will show the notch into which the lever drops to lock the chuck and work. This is all mounted on a drill press

* Machines having a capacity of 500 tons every twenty-four hours.

table, which, it will be noticed is very substantially blocked underneath to insure rigidity. These fixtures are numerous, being varied to suit the work in hand and it is needless to say are very effective in the economical production of this class of work. The boring and finishing of the plug cocks used in this work is also interesting and may be mentioned later; for the present it will suffice to say that special lathes are employed and the work turned out is handled in an economical manner.

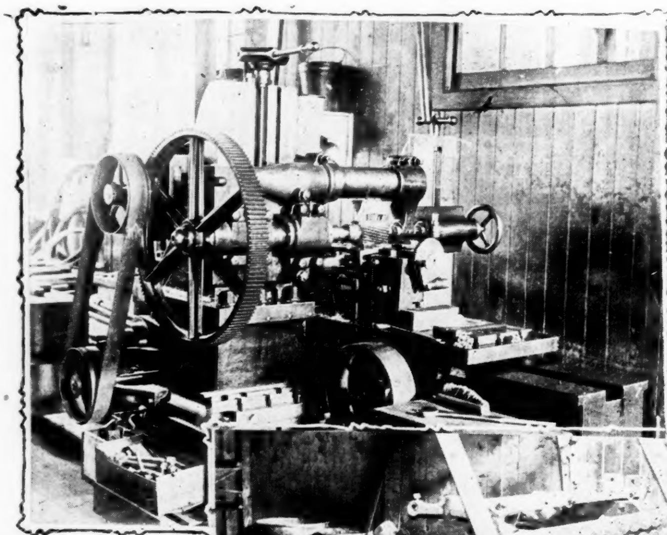
Much remains to be said in connection with the pattern room, smith shop and other departments of the work, but before touching on anying else it is in order to mention—with kind words and a sort of "moreish" feeling—the excellent dining room, about 30x35 feet in size, where the members of the professional and clerical force dine. A tour of observation, accompanied by a camera, tripod, plate holders, etc., etc., the climbing of stairs, selecting of positions and inevitable uncertainty as to whether the picture will be under or over exposed (as quality and quantity of light is sometimes "unsartin") had whetted an appetite which is normally in good condition, and full justice was done to the dinner from soup to pie.

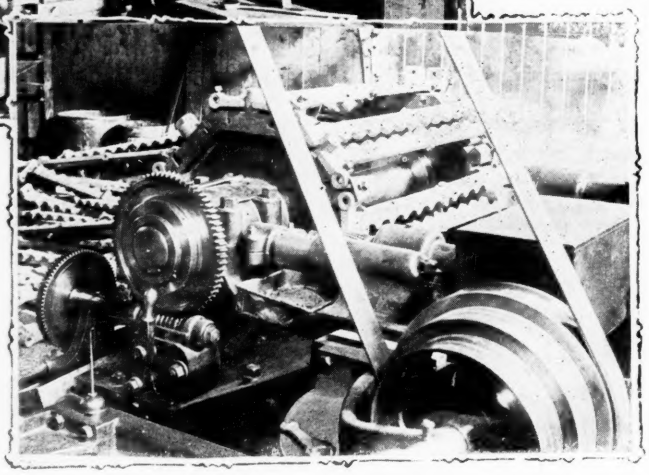
To mention the De La Vergne Company at this time and not speak of the Hornsby-Akroyd oil engine would be like a rendering of Hamlet without the Danish prince. They have recently taken the United States agency for these engines and having placed this department in the hands of Mr. George Richmond, are pushing its manufacture and sale with their accustomed energy. Briefly, the engine is an oil engine pure and simple, not gasoline or steam raised with oil as are some so-called oil engines, and its simplicity is a very attractive feature. There is no ignition tube, no flame and no electric spark to ignite the mixture of oil and air. The oil is pumped from a reservoir in



A DRILL PRESS FIXTURE—DE LA VERGNE REFRIGERATING CO.

the base of the engine in a constant quantity, sufficient for the full power of the engine. A Porter governor controls a by-pass valve which admits to the cylinders only as much oil as the work requires, the remainder escaping from an overflow and running back to the reservoir. Air is drawn into the cylinder, and the oil is forced into the vaporizer, just behind it and communicating with it; the "in" stroke of the piston compresses the air into the vaporizer, mixes it with the oil,





TWO MILLING MACHINES—DE LA VERGNE REFRIGERATING CO.

and, when the piston is at the extreme inner end of its travel or possibly just starting back, the mixture being right, the temperature of the vaporizer is sufficient to explode the charge. The vaporizer is heated on starting by a lamp or gas jet, after which the explosions maintain the temperature and no further attention is required. It is stated that with a five horse-power engine an economy of a little less than a pint of oil per brake horse power per hour has been obtained. Although an oil weighing about 8¼ pounds per gallon and flashing at 101 degrees Fahr. is recommended, it can by proper adjustment, use oils as heavy as 9 pounds per gallon (heavier than water), giving it a wide range of adaptability, which, added to its simplicity, should make it many friends. Its operation is noticeably steady and the regulation can be easily noted by watching the variation in the overflow of oil; an increase in load immediately diminishing overflow.

* * *

Through a mistake in this office, an old advertisement of the Westinghouse Machine Company's, which was written last January, was used in August in place of their regular copy, and like most printer's errors, the substituted matter was singularly inappropriate. The advertising department of the Westinghouse Machine Company is managed with great care, new copy being sent out for each issue of every paper that carries their advertisement, so that a mistake of this kind is doubly annoying to both advertiser and publisher.

* * *

IT MADE A DIFFERENCE.

An amusing incident is told by Mr. Vial, the genial superintendent of the Brown & Sharpe Mfg. Co., which illustrates the sudden fluctuation of values under different conditions. A visitor was expatiating upon the beauties and usefulness of their micrometer caliper and said: "If you only made them larger, to measure up to six inches, they would be so valuable. Why, Mr. Vial, I would give a hundred dollars for one of your micrometers that would measure up to six inches." "Well," said Mr. Vial slowly, "we have one we made several years ago, and we won't ask you nearly as much as that, you can have it for twenty-five dollars." But on finding that he could buy one, its great usefulness apparently vanished, and he muttered something about "he guessed he wouldn't take it just then."

MACHINE SHOP ARITHMETIC.

A series of practical articles clearly explaining the portions of mathematics which will be useful to the men in the shop and engine room.

PRACTICAL QUESTIONS REGARDING ANYTHING IN THIS LINE WILL BE PROMPTLY ATTENDED TO.

SOMETHING ABOUT DECIMALS.

CALEB TOPMAM.

"Say, Mr. Topham, what does this mean, we always used to make these bolts $3\frac{1}{8}$ inches long, but this new duck of a draughtsman has marked this with four figures, 3, 1, 2, 5, so, 3.125; now if that means $3\frac{1}{8}$ inches I'd like to know how to read that kind of figures." "You forgot something in reading that," said I; "that period between the 3 and the 1 fixes the value of that number." "Period! thought 'twas a fly-speck, and just put it in for fun when I wrote it out; but what difference can that make, anyhow?" "Well, Tom, I'll try and show you this to-night and if you'll come up to the house, we'll talk it over." Night came, Tom ditto, and we tackled decimal fractions in this manner. "That period, Tom," said I, "is the decimal point and all figures to the left are whole numbers, while all to the right are decimal parts of 1. How do I know *what* part of 1? Well, you just call that point 1 and add a cipher for each figure to the right of the point, in this case it is 1 and three ciphers, or 1000 for the denominator of the fraction, and putting the right-hand part of the figures over this gives the fraction as $\frac{125}{1000}$, which is the decimal which equals one eighth of 1. How do I know that? Because 125 (the numerator or top figures) multiplied by 8 equals 1000, making $\frac{1000}{1000}$, or 1. Or another way is to take $\frac{1}{8}$ and find its value decimally. How do I? Hold on and I'll tell you; you're in too much of a rush to absorb knowledge into that No. 7 cranium of yours, but I want you to ask questions. To change a common or vulgar fraction into a decimal we simply divide the numerator by the denominator, taking care *to put the decimal point in the right place*, as its position has a great effect on values, as you will see. In dividing 1 by 8 we simply say

$$8)1.000$$

putting a point after the 1 and adding as many ciphers as we wish decimals; four places in the answer, unless it comes out even before, will usually give all the accuracy required. This gives us 125 for an answer, and as there are three ciphers after the 1 in the dividend we know there must be three in the quotient or answer, so beginning at the *right*, we count three and put the point in front of the third, making it read .125 or 125 thousandths, as we said before. It's very handy to have a little table to refer to, and I'll give you one later, but for the present you want to learn how to find them yourself." "But what's the use of changing fractions to decimals, and what's the use of decimals anyhow; ain't there enough to puzzle a poor shop cub without firing *two kinds* of 'rithmetic at 'em?" "Aisy, Tom," as old Mike, the sweeper, says, "wait awhile and see what it will save you in figures, and besides, they are used in all calculations by engineers and scientists, are so much more compact and convenient that all engineers' pocket-books use them, so that if you don't understand them you lose much information that you could otherwise get. As an example find the area of a square flue $3\frac{1}{2}$ inches square, $3.5\times3.5=12.25$; now isn't this just as easy as saying $3\frac{1}{2}\times3\frac{1}{2}$ and then changing all to fractions, as $\frac{7}{2}\times\frac{7}{2}=\frac{49}{4}=12\frac{1}{4}$? Although there is an easy way of multiplying $3\frac{1}{2}$ by $3\frac{1}{2}$, or any other fraction ending in $\frac{1}{2}$, by itself, and by the way this is called 'squaring' a number. The 'trick' is to add 1 to one whole number and multiply by the other, adding the product of the fractions. Or taking $3\frac{1}{2}\times3\frac{1}{2}$ we have $3+1=4$, multiplied by $3=12$, and adding $\frac{1}{2}\times\frac{1}{2}=\frac{1}{4}$ we have $12\frac{1}{4}$ as before. Taking $5\frac{1}{2}$ by $5\frac{1}{2}$ we have $5\times6=30$, plus $\frac{1}{2}\times\frac{1}{2}=\frac{1}{4}$ or $30\frac{1}{4}$, by remembering that this always ends in $\frac{1}{4}$ we can say that we add 1 to one number, multiply it by the other and add $\frac{1}{4}$; this will come in handy for 'head figuring,' or what scholars call mental arithmetic, and it's good exercise too, Tommy. But we're getting off the track, and before going any farther I want to tell you a little more about this decimal point. In adding or subtracting always place the points *under* each other, as in subtracting 3.125 for 5.25 we have

$$\begin{array}{r} 5.25 \\ \underline{3.125} \end{array}$$

When there are no figures over any part or the whole of the decimal portion of the smaller and lower number, go ahead just as though it was a cipher or ten over it, and we have

$$\begin{array}{r} 5.25 \\ \underline{3.125} \\ 2.125 \end{array}$$

as the difference, which happens to be the length of the short stud next to that bolt that you found marked with a "fly-speck" number. In multiplying decimals you find the number of places to point off by *adding* the decimal places of the two numbers multiplied, as where we multiplied 3.5 by 3.5 we had 12.25 for the answer. In dividing we point off as many places as the decimals of the dividend (or number divided) exceed those of the divisor. If the dividend has less than the divisor, add ciphers and in pointing off the answer count all that have been *used* in the example. Now about pointing off. Taking our old friend, the bolt, which is marked 3.125 inches, it is plain that 3 is a whole number, being to the left of the point. Now if the point is moved between the 1 and 2, as 31.25, we multiply it by 10, so we see that it is very important to place it *right*; and further, that we can multiply by 10, by 100, by 1000, etc., by simply moving the decimal point one, two, three or more places to the *right*, and of course *divide* by similar numbers by moving it to the *left*, and for this reason it is all important to have the point in the right place. Perhaps it may help you a little sometimes to know that in a great many English books you will find the decimal point about the middle (in height) of the figures, instead of at the bottom as we do, and when you see figures like this, 3·125.1·15, it means 3.125 multiplied by 1.15, the point on the line between the figures being sometimes used to denote multiplication. "But, Mr. Topham, you haven't showed me yet how we save very much time by using decimals." "No, I've been explaining too much for that, but now take a case where you have to multiply $3\frac{1}{4}$ by $3\frac{13}{32}$. Your way, you have to reduce it to fractions and multiply as we did before. By decimals we say

$$\begin{array}{r} 3.40625 \\ \underline{3.25} \\ 1703125 \\ 681250 \\ \underline{1021875} \\ 11.0703125 \end{array}$$

pointing off seven figures because one term has five decimal places and the other two, but when you get to working formulas you'll find it a great time saver."

"Say, Mr. Topham, I found something in fractions in a paper the other day that kinder staggered me, and though it may seem like going backwards, I wish you'd show me how to do it; here it is." And he produced a complex fraction, as follows:

$$\frac{\frac{2}{3}\times\frac{7}{8}\times\frac{1}{4}}{\frac{1}{4}\times\frac{5}{8}\times\frac{1}{8}}$$

"Well, Tom, that is simply one set of fractions divided by another, and though you could cancel (or cross out) the $\frac{1}{4}$ above the line and the $\frac{1}{4}$ below it it will be better to work it all out, so we say $\frac{2}{3}\times\frac{7}{8}\times\frac{1}{4}=\frac{14}{96}$ and $\frac{1}{4}\times\frac{5}{8}\times\frac{1}{8}=\frac{5}{256}$, $\frac{14}{96}\div\frac{5}{256}$ equals $\frac{14}{96}$ *muliplied by the divisor inverted*, or $\frac{14}{96}\times\frac{256}{5}=\frac{3584}{480}=7\frac{224}{480}$, or $7\frac{17}{40}$ or to reduce the decimals to 7.466. It's easy enough to work these

if you go at it right; work out each part by itself and then perform the final operation on the results. And now, Tom, if there are any questions to ask, go ahead; if not, we'll call it quits for to-night and try something else the next time you feel like coming up in the evening." "I'll think this over, Mr. Topham, and try a few cases of decimals and let you know if I get stuck; but you said something about formulas, and that is something I have tried to understand, but can't. A whole mess of letters, multiplication signs and bent fish-hooks don't mean much to me, but I s'pose I'll get the hang of it some of these days." "They're easy, Tom, at least some of them are, and we'll see about them next time, if you don't get stuck on decimals and forget to come, and here is that table of decimals, parts of an inch I mentioned before, it's from Brown & Sharpe's catalog, and will be useful for reference at any time. Get the pattern-maker to glue it on a light board and give it two coats of white varnish, and you can keep it in your tool-box to use whenever you want to, as it can be easily wiped off when it gets dirty.

TABLE OF DECIMAL EQUIVALENTS

OF 8THS, 16THS, 32NDS, AND

64THS OF AN INCH.

8ths.	$\frac{9}{32}$ = .28125	$\frac{19}{64}$ = .296875
$\frac{1}{8}$ = .125	$\frac{11}{32}$ = .34375	$\frac{21}{64}$ = .328125
$\frac{1}{4}$ = .250	$\frac{13}{32}$ = .40625	$\frac{23}{64}$ = .359375
$\frac{3}{8}$ = .375	$\frac{15}{32}$ = .46875	$\frac{25}{64}$ = .390625
$\frac{1}{2}$ = .500	$\frac{17}{32}$ = .53125	$\frac{27}{64}$ = .421875
$\frac{5}{8}$ = .625	$\frac{19}{32}$ = .59375	$\frac{29}{64}$ = .453125
$\frac{3}{4}$ = .750	$\frac{21}{32}$ = .65625	$\frac{31}{64}$ = .484375
$\frac{7}{8}$ = .875	$\frac{23}{32}$ = 71875	$\frac{33}{64}$ = .515625
16ths.	$\frac{25}{32}$ = .78125	$\frac{35}{64}$ = .546875
$\frac{1}{16}$ = .0625	$\frac{27}{32}$ = .84375	$\frac{37}{64}$ = .578125
$\frac{3}{16}$ = .1875	$\frac{29}{32}$ = .90625	$\frac{39}{64}$ = .609375
$\frac{5}{16}$ = .3125	$\frac{31}{32}$ = .96875	$\frac{41}{64}$ = .640625
$\frac{7}{16}$ = 4375		$\frac{43}{64}$ = .671875
$\frac{9}{16}$ = .5625	**64ths.**	$\frac{45}{64}$ = .703125
$\frac{11}{16}$ = .6875	$\frac{1}{64}$ = .015625	$\frac{47}{64}$ = .734375
$\frac{13}{16}$ = .8125	$\frac{3}{64}$ = .046875	$\frac{49}{64}$ = .765625
$\frac{15}{16}$ = .9375	$\frac{5}{64}$ = .078125	$\frac{51}{64}$ = .796875
32nds.	$\frac{7}{64}$ = .109375	$\frac{53}{64}$ = .828125
$\frac{1}{32}$ = .03125	$\frac{9}{64}$ = .140625	$\frac{55}{64}$ = .859375
$\frac{3}{32}$ = .09375	$\frac{11}{64}$ = .171875	$\frac{57}{64}$ = .890625
$\frac{5}{32}$ = .15625	$\frac{13}{64}$ = .203125	$\frac{59}{64}$ = .921875
$\frac{7}{32}$ = .21875	$\frac{15}{64}$ = .234375	$\frac{61}{64}$ = .953125
	$\frac{17}{64}$ = .265625	$\frac{63}{64}$ = .984375

* * *

SHRINK FITS.

A fair allowance for shrink fits is .0025 to .0035 times the diameter of hole, the former being for a heavy solid piece like the solid piston of a steam engine, and the latter for pieces with a hole, or with a moderate amount of metal around the hole. In shrinking the parts together, the casting should be heated no hotter than is necessary to permit them to go together readily. A red heat is not likely to improve the casting, besides heating the rod or shaft more than is necessary, It is advisable, when practicable, to have clamps in readiness to clamp the casting firmly back against the shoulder on the shaft; this will prevent the little gap so frequently seen between the casting and the shoulder. The .0025 allowance may also be used for large fits. Thus on a 20 inch fit this would give 20×.0025=.05 inch. For press fits it is not practicable to make a definite allowance per inch of diameter. One manufacturer allows for diameters from 3 inches to 7 inches, and holes about 1 diameter in length, .001 inch per inch of diameter, plus a constant of .003 inch. This would give for a 7 inch fit .007+.003=.01 inch. Making the same allowance for a 10 inch shaft, fit 10 inches long into a disc, as in the instance of a disc crank, a pressure of nearly 100 tons would be required to force together. In the foregoing the turning and boring is supposed to be smoothly done, and the cast iron is not supposed to be "spongy," or porous. As this is not always the case, any rule for allowance must be modified according to existing conditions. Few rules for anything in the lines of mechanics are of much use when handled by inexperience. Running fits should be from .0005 to .00075 inch loose. This is not too much room for oil, for a nice fit. On coarse work the allowance may be considerably greater. Where, on extremely fine work, it is found advisable to make fits closer than given above, the bearing surface should be so large that quite light oil may be used and the best of facilities should be provided for getting the oil where it is needed.—*The Tradesman.*

* *

FOR THE NOTE BOOK.

UNDER THIS HEAD WE WILL PUBLISH PRACTICAL RULES AND DATA THAT WILL, FOR THE MOST PART, BE FOUND USEFUL TO SHOPMEN GENERALLY; AND WE SHALL BE PLEASED TO CREDIT ANY CONTRIBUTION TO IT.

QUESTIONS CONCERNING ANY OF THESE WILL RECEIVE CAREFUL ATTENTION.

JOT THIS DOWN.

KNOWING that a plate of wrought iron 1 inch thick weighs 40 pounds, a very easily remembered rule can be made for use in work where iron sheets are used. For if a square foot 1 inch thick weighs 40 pounds, a square foot ½ inch thick will weigh 20 pounds, ¼ inch thick 10 pounds, and *a square foot ⅛ inch thick 5 pounds*, and as sheets in common use vary from ⅛ to ½ inch in thickness, the last unit will be found the best, calculating the thickness of sheets by *eighths*. Thus if we have a sheet 2 by 4 feet and ⅜ inch thick, we find its weight by saying 2 ×4=8 square feet. If a square foot ⅛ inch thick weighs 5 pounds, one ⅜ inch thick will weigh 15 pounds and 8×15=120 pounds for the sheet. If sheet is $\frac{5}{16}$ inch thick, it is 2½ *eighths* and weighs 2½× 5=12½ pounds per square foot. For less than a square foot it may be easier to reduce it to inches, and if 144 square inches weigh 5 pounds, one square inch will weigh 5÷144=.0347 of a pound per square inch, ⅛ *inch thick*. A sheet 10×12 and $\frac{5}{16}$ inch thick would weigh 10×12=120 square inches, 120×.0347=4.164 pounds; $\frac{5}{16}$=2½ *eighths*, and 2½×4.164=10.41 pounds. This could be worked out in several different ways, but this seems as simple as any, the others can be worked out by those who choose to do so. For the note book we say: One square foot of iron 1 inch thick weighs 40 pounds, ⅛ inch thick weighs 5 pounds. One square inch 1 inch thick (one cubic inch) weighs .277 pounds, ⅛ inch thick weighs .0347 pounds. Area in *square feet* × thickness in *eighths* × 5=weight in pounds. Area in *square inches* × thickess in *eighths* ×.0347=weight in pounds.

PROPERTIES OF METALS.

FROM DIFFERENT SOURCES.

	Melting Point. Degrees Fahrenheit.	Weight in lbs. per cubic foot.	Weight in lbs. per cubic inch.	Tensile Strength.
Aluminum	1140	166.5	.0963	15,000-30,000
Antimony	810-1000	421.6	.2439	1,050
Brass (average)	1500-1700	523.2	.3027	30,000-45,000
Copper	1930	552.	.3195	30,000-40,000
Gold (pure)	2100	1200.9	.6949	20,380
Iron, cast	1900-2200	450	.2604	20,000-35 000
" wrought	2700-2830	480	.2779	35,000-60,000
Lead	618	709.7	.4106	1,000-3,000
Mercury	—39	846.8	.4900	....
Nickel	3000	548.7	.3175	....
Silver	1800	655.1	.3791	40,000
Steel	2370-2685	489.6	.2834	50,000-120,000
Tin	475	458.3	.2652	5,000
Zinc	780	436.5	.2526	3,500

NOTE.—The wide variations in tensile strength are due to the different forms and qualities of the metal tested. In the case of lead, the lowest strength is for lead cast in a mold, the highest for wire drawn after numerous workings of the metal. With steel it varies with the proportion used in mixing, which is varied according to the grade required. Mercury becomes liquid at 39 degrees below zero.

A TRICK OF CALCULATION.

We frequently desire to find a simple expression, or formula, for an infinite series of numbers; a little trick of calculation enables us to do this. We can, so to speak, measure up infinity without going to the farther end of it. For instance, we take the arithmetical expression, 0.333, which if continued indefinitely, it is believed will finally round up a full ⅓; but how can we prove this? This decimal is unmanageable, and cannot be permitted to enter into combination with whole numbers without rectification.

Let S=0.3333, etc., *ad finitum*,

then $S=\frac{3}{10}+\frac{3}{100}+\frac{3}{1000}+\frac{3}{10000}$, etc., *ad finitum.*

Now let us subtract $\frac{3}{10}$ from each side of this equation and we will get $S-\frac{3}{10}=\frac{3}{100}+\frac{3}{1000}+\frac{3}{10000}$. Now multiply both sides of this equation by 10 and we will get $10S-3=\frac{3}{10}+\frac{3}{100}+\frac{3}{1000}$, etc. We now have on one side the original equivalent of S, and therefore we may put S in its place, which will give us 10S−3=S. Transposing we get 9S=3, and dividing each side by 9 we get $S\frac{3}{9}$, which is equal to ⅓ exactly.

Philadelphia, Pa. JOHN H. COOPER.

HOW AND WHY.

A COLUMN INTENDED TO GIVE CORRECT ANSWERS TO PRACTICAL QUESTIONS OF GENERAL INTEREST. GIVE ALL DETAILS AND YOUR NAME AND ADDRESS, WHICH WILL NOT BE PUBLISHED UNLESS DESIRED.

1.—A. F. T., San Francisco, Cal.: 1. How do you calculate the H. P. and M. E. P. pressure of each cylinder in a triple expansion engine, each cylinder cutting off at ⅓ stroke, steam 145 lbs. gage? *A.* Add 15 to 145 making it 160 lbs. absolute. Initial pressure × hyperbolic logarithms of expansions + 1 ÷ number of expansions = forward pressure 1.0986 × 1 = 2.0986,

$$\frac{160 \times 2.0986}{3} = 111.925$$

equals forward pressure. Back pressure equals (theoretically) the terminal pressure = initial pressure divided by expansions 160 ÷ 3 = 53.33. Forward pressure minus back pressure equals mean effective pressure. 111.925 − 53.33 = 58.595 lbs. M. E. P. for first cylinder. Initial to intermediate equals terminal of high pressure cylinder, or 53.33 equals initial in this case. By same process as before we have

$$\frac{53.33 \times 2.0986}{3} = 37.306$$

forward pressure in intermediate cylinder. 53.33 ÷ 3 = 17.77 lbs. terminal pressure and 37.306 − 17.77 = 19.53 lbs. M. E. P. The same process gives a M. E. P. of 6.51 lbs. and a terminal of 5.92 lbs. To find H. P. developed in each cylinder multiply piston area, by feet in speed per minute, by M. E. P of that cylinder and divide the entire product by 33,000. In practice there will be a "drop" in pressure between each cylinder which must be allowed for, and as there is almost sure to be leakage, condensation and interval friction you must not expect to get this full power out of the engine.

2.—H. P. L., Rome, N. Y.: 1. How can we start an engineer's society here? *A.* Pres. M. D. Nagle, of the N. A. S. E., answers this as follows: "To organize an association it requires seven or more engineers who have not been suspended or rejected from any subordinate association, who by notifying the executive office can have a deputy sent to instruct and install them. The fee for charter and supplies is $20, which covers all expenses and entitles to all the benefits of the order."

3.—G. E. O., Philadelphia, Pa.: 1. How does heating wrought iron bars affect their strength? *A.* Haswell gives experiments in which from one to six reheatings and rollings increased the tensile strength from 43,904 to 61,824 pounds per square inch, while the next six again reduced it to the original figure. Experiments at the Franklin Institute indicate that bars which showed 56,000 pounds tensile strength per square inch at 80 degrees, increased to 66,500 pounds at 570 degrees, after which they decreased to 55,000 pounds at 720 degrees, 32,000 pounds at 1,050 degrees, 22,000 pounds at 1,240 degrees, and 9,000 pounds at 1,317 degrees. Annealing is said to reduce the strength fully 1 ton per square inch, although roughly speaking, from zero to 400 degrees the strength remains fairly constant, while heating to redness decreases strength 25 per cent.

4.—F. S., Dover, N. J.: 1. What is meant by coefficient of friction? *A.* It is the relation between pressure and resistance of one surface over another, or the percentage of the weight of a body required to move it over any surface. If a block weighs 10 pounds and a pressure of 1 pound would move it over a smooth cast iron plate, the coefficient would be .1 or $\frac{1}{10}$, because $\frac{1}{10}$ of its weight would move it. On a plank it might require 2 pounds to move the same block, and in this case the coefficient would be double, or $\frac{2}{10}$ of its weight. 2. How is it determined? *A.* If the coefficient of friction between wrought iron and cast iron is desired, take a block of one (of known weight) and place it on a plate of the other metal. By a cord and pulley or a good spring balance (former method preferred) find what force is required to move it. The force (or weight) required to move the block is the numerator of a fraction, the weight of body moved being the denominator, which for convenience is reduced to a decimal fraction. If the weight is 8 pounds and weight required ½ pound, then $\frac{1}{2} \div 8 = \frac{1}{16} = .166+$ as coefficient of friction.

* * *

An easy and quick way to divide by 12½ is: Multiply by 8, and "point off" two places, example $\frac{250}{12\frac{1}{2}}$ = (250x8) = 20.00.)

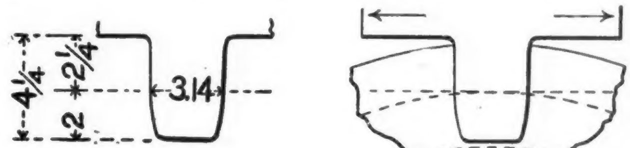
WHAT MECHANICS THINK.

THIS COLUMN IS OPEN FOR THE EXPRESSION OF PRACTICAL IDEAS OF INTEREST, TECHNICAL OR OTHERWISE. WRITE ON ONE SIDE OF THE PAPER ONLY, AND BOIL IT DOWN.

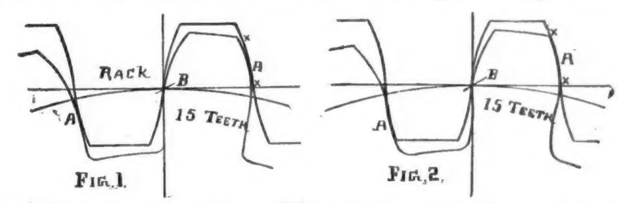
WHEN SKETCHES ARE NECESSARY TO ILLUSTRATE THE IDEA, SEND THEM ALONG—NO MATTER HOW ROUGH THEY MAY BE, WE WILL SEE THAT THEY ARE PROPERLY REPRODUCED.

GEAR TEETH—BELTS.

In originating the shape of the teeth of wheels I employ the following method: I have various forms of rack teeth suitable to make gearing from; such as, special epicycloid teeth, the 7½ inch (1 pitch) describing circle, epicycloid teeth, cycloid teeth, improved radial teeth, Willis involute teeth, improved involute teeth, etc., and these are of large size, ½ diametral pitch as follows:



I have a method of ascertaining the exact form of the teeth of wheels of any number of teeth from rotating uniformly, thus:

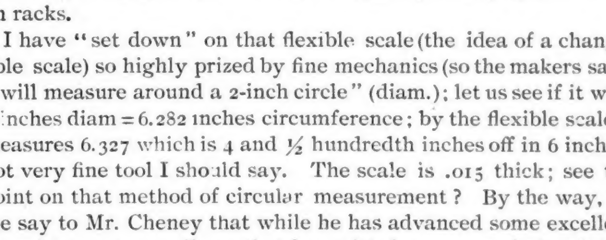


as if the rack tooth were a milling cutter mounted on a slide and would cut out an exact space between teeth; this I find is very much more accurate than the rolling process.

The simple idea is that the teeth of wheels are originated from suitable rack teeth and are interchangeable with any of the same pitch thus originated.

Regarding forming teeth by conjugating I will say that the originating form of the *special epicycloidal* tooth on wheel obtained by conjugating is the regular 7½, 1 pitch, epicycloid tooth on racks.

I have "set down" on that flexible scale (the idea of a changeable scale) so highly prized by fine mechanics (so the makers say); "will measure around a 2-inch circle" (diam.); let us see if it will; 2-inches diam = 6.282 inches circumference; by the flexible scale it measures 6.327 which is 4 and ½ hundredth inches off in 6 inches; not very fine tool I should say. The scale is .015 thick; see the point on that method of circular measurement? By the way, let me say to Mr. Cheney that while he has advanced some excellent thoughts on cone pulleys, that he omitted one very vital point in his calculations and that he only gets there in part. Let me give you a problem involving the point at issue. Suppose our main shaft runs 150 turns per minute, now the machine pully is 12 inches diameter and we want it to run exactly 300 turns per minute; what shall the size of pulley be on the main line? I say 24¼ inches; my learned friend *Axis* tells me that it should be 24 inches. My *semi-technic* friend tells me 24 inches and allow "a little" (he don't know just how much, so guesses about an eighth or so) for slip of belt (!); neither are right; one is trying to use belts of no thickness in calculation, the other makes too much account of belt slipping. The speed ratio of shafts and pulleys is the pitch line of belt, or half its thickness, thus:



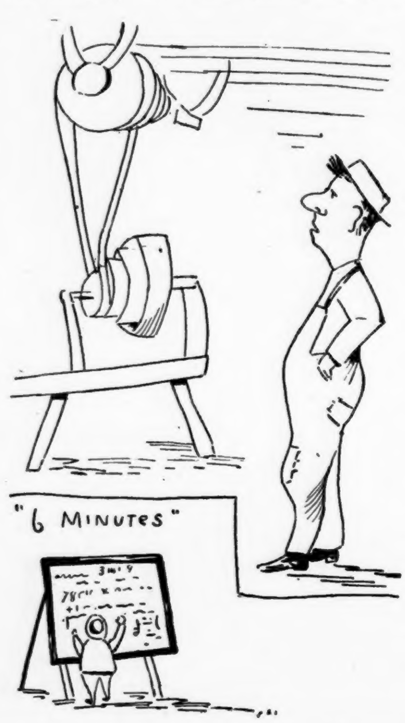
My friend, "Uncle John," an old "jour" once got caught on figuring as *Axis* tells me is correct. The —— Mfg. Co. gave him an order for a special counting device to be run just 400 times in a given time of the machine, requiring multiplication from ma-

chine of 4 to 1; the pulley on machine was 3 inches, so Uncle John made pulley on counter 12 inches diam; when set up the company used quite a thick belt and reported to Uncle John that his device ran about 20 counts wrong; he went to see about it and noticed the extra thick belt (½inch); he took it off and tried a thin cotton web belt and it came very near the requirement (about 5 revolutions), but the Manufacturing Co. wished to use the thick belt, so Uncle John added to the 12-inch pulley until he got the speed exactly; it stood thus: 3 inches+.25=3.25 pitch line of belt on small pulley; 3.25×4=13 inches for pitch circle of belt on large pulley, 13—.25=12.75 for diameter of large pulley, see ? The thickness of belt always enters into figuring on pulleys which vary in size. This same principle enters into cone pulley calculations. You see that this must be so on varying speeds. I have a rule in my traps somewhere which I marked out some years ago for cone pulleys; later I will send it to you for inspection. Friend "Easy-go" says it is too deep for him, but it gets there when the belt calculated for is used, exact to a T.

F. W. Clough.

CALCULATING CONE PULLEYS.

Having read Mr. Cheney's article with interest, and being personally acquainted with the author, the vision comes to me of his problem and its solution. I see him in his regimentals in the shop, and there is evidently something wrong with the cones of the lathe (one he bought—all he makes are O K., of course), judging from the "in-shoot" on the curve of the belt. A few dimensions taken, the blackboard comes into play and figures chase each other in a mathematical game of hide and seek till the problem is solved in just six minutes by the clock, and the little cuckoo (that is supposed to be on clocks, but isn't—very often) steps out and calls itself names. The drawing-board plan may have its good points, but it didn't get in shape to appear in the vision before time was called, and brother Cheney's method won the game.



Boston, Mass. A. Cousin.

SETTING THE VALVE OF AN ENGINE.

I was called upon once to take charge of a portable engine, and after looking it over to see that everything was all right, I started up (we were running a rock crusher with the engine). Having only 40 pounds of steam I thought I could run the steam up to 80 or 90 pounds without any trouble, but I soon found that I was mistaken, for instead of going up the steam commenced to run down, and it was all I could do to hold it for awhile. At noon when we stopped I looked it over and came to the conclusion that the valve had no lead, but not having time to take off the bonnet and adjust the valve properly, I used the drip-cocks instead. Opening them I threw the engine on center as near as I could guess and opened the throttle slightly, but no steam appeared at the cocks. I then closed the throttle and rolled the engine forward and the crank stood at about 45 deg. ahead when steam appeared at the drip-cocks. I then rolled it back to the center again and loosened the eccentric, opened the thottle a little, and rolled the eccentric forward until steam appeared at the drip-cocks, and then screwed it fast; as the lead was equally divided that was all that was necessary. Then I need not say that the engine used about one-quarter less wood and run a great deal quieter than it did before. When I had time I took off the bonnet of the steam chest and found that before I set the valve forward it was nearly ½ inch late in opening. The engine is running very well at present, and has given very little trouble since.

I. A. C.

THE USE OF ECONOMIZERS.

Mr. A. H. Blackburn, in your May issue, says, in regard to my article on High Chimneys, "Mr. Le Van evidently thinks that an economizer can only be used successfully with forced draft, but this is not the case at all, as 95 per cent. of the thousand of economizers that are working successfully to-day in Europe and in this country are connected to chimneys direct, without any mechanical means of assisting the draft."

Now the facts are that the majority of the boilers in use are badly designed and improperly erected in their brick settings, due to having so small a combustion chamber between the fire grate and the water spaces, as well as an inadequate supply of air above as well as under the grates to produce proper combustion. Again, in the setting of boilers as commonly practiced, no provision is made for thorough combustions of the fuel, as to time, for unless the gases evolved have time to be thoroughly commingled with the air and heated to the ignition temperature, they pass away only partially utilized, as *carbonic oxide*, instead of *carbonic acid*, many degrees higher than that of the steam in the boiler.

This great loss of heat units through the chimney is what gave birth to the introduction of the so-called economizer, which in fact is a secondary boiler, to utilize the waste heat. A properly proportioned boiler, completely encased in brick work with large combustion chamber supplied by heated air, and the waste gases passed around the steam drum, the latter isolated from the water space, will in reality accomplish all that the economizer can do, and will give dry steam at a temperature of 50 to 100 degrees above that of the steam in its otherwise wet or saturated condition.

As Mr. Blackburn remarks 95 per cent. of the boilers have economizers, showing bad boiler engineering. Manufactures as a rule, when in want of a boiler buy the cheapest suitable for their purpose, regardless of subsequent economy or the production of dry steam and are satisfied to ever afterward pay in installments in the way of extravagant monthly coal bills which could be avoided by paying from ten to twenty per cent. additional for a properly set boiler in the first instance which would within five years save the price of the boiler in the value of coal saved. The first cost of a boiler is a fixed quantity. The cost of running it is one continuing during the life of it.

It is taken for granted by the majority of boiler users that a boiler need only be a shell, or tank, to hold water and then surrounded by fire to generate steam and the steam so generated passed to the engine. Beyond this they do not investigate. Not only are cheap boilers used, but also cheap attendants. One who can throw coal on the fire grate and wheel out ashes, one who delights to have the boiler filled with water to the top gage, so he may have time to fill his pipe and read his paper or take a snooze as his inclination may be, will answer. The question of his evolving carbonic oxide or carbonic acid does not enter into his thoughts. The boiler full of water and the grate heaped with coal is the height of his ambition. With a high chimney, a properly brick-set boiler and an intelligent fireman, an economizer will not be needed, the cost of which, in the first place, will be less than a badly set boiler with an economizer.

Philadelphia, P. W. Barnet Le Van.

ANOTHER ESSAY FROM OUR OLD FRIEND.

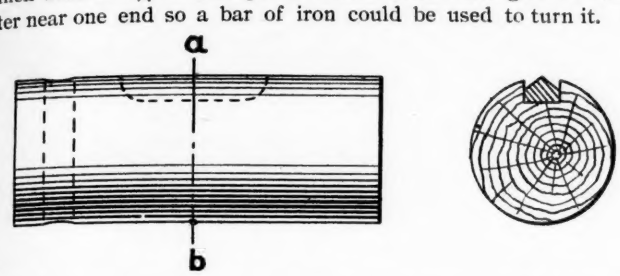
Mister editur—i went to cell sum wood skruze to the purchasin agint of a facktery, and he sez, get out you chump, we doan uze no wood skruze this iz A 1st klas plais & orl our skruis iz made of iron. durn a purchasin aigent ahyhough, yours till deth,

Constant Reader.

AN IMPROVISED BORING BAR.

There is an old device for reaming out a hole, which I came across lately, and as it struck me as being quite ingenious and effective for the purpose for which it was used, thought I would describe it for those readers of Machinery who like myself never saw or heard of it before; the occasion for its use being that the crank-shaft of a large riveting machine having broken, a new one was turned up and the center cut out before trying it in its place. It was then found too large for the hole. The bearing was about 9 inches in diameter and 14 inches long. There was no boring bar or reamer on hand for the size, and the half-round scraper, the usual resort in such cases, could not conveniently be

used, and even if it could the device would come out ahead about 10 to 1. A log of wood was put in a lathe and turned up to fit a little easy; it was then slotted with a milling cutter about $\frac{3}{8}$ inch wide and $\frac{3}{4}$ inch deep, and a hole drilled through the diameter near one end so a bar of iron could be used to turn it. A



special shaped cutter was used (any other form would probably chatter) as shown in the sketch, and packing was placed in the slot beneath the cutter as required. This made a smooth hole, a hundreth of an inch being removed in about four hours. This device is said to work well on about any kind of metal.

Providence, R. I. J. T. G.

* * *

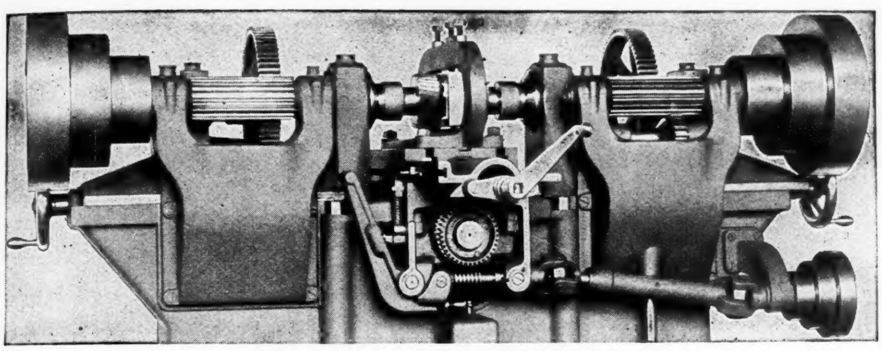


FIG. 1.—DUPLEX DOUBLE-COLUMN MILLING-MACHINE.

DUPLEX DOUBLE-COLUMN MILLING-MACHINE :

This is a modification of the Bogart Patent Double-Column Milling-Machine designed for the large class of work that can have two sides operated on simultaneously. Each head-stock is driven by a separate cone and gearing, although but one counter-shaft need be used. The use of long steel pinions, to engage with the gears on the spindles, makes possible the horizontal adjustment of the head-stocks with the minimum resistance. Greatest distance between the ends of the spindles 18-in., least distance, $3\frac{3}{8}$-in. Vertical adjustment of the saddle $12\frac{3}{4}$-in.; in the lowest position of the saddle the top of the table is $12\frac{3}{4}$-in. below the line of centers. The table is $9\frac{9}{16}$-in. wide. 46- or 52-in. long and has automatic power feed 25- or 30-in., according to its length.

Cut No. 1 shows a connecting-rod strap with its top and bottom held by hardened steel screws in a frame or fixture which is bolted to the table, thus presenting its sides for simultaneous milling. This should be the first work done on a strap after it comes from the forge. The fixture here shown will accommodate quite a range of sizes; in fact, it will hold all the different straps made in the average agricultural steam-engine works. To keep the upper and lower part of the strap from springing together, under the pressure of the chucking screws, a small jack-screw or strut is placed in the open end of the strap. Comparatively thin work may be thus milled on both sides at the same time, the chucking principle being the same as where work is held between the centers of a lathe. After the sides of a strap have been milled parallel, the next operation should be the slotting or planing of the inside. No milling-machine on the market is adapted to the inside milling of straps intended for square boxes. Except the machining of the inside, this milling-machine is designed to do all the rest of the work.

Cuts Nos. 2 and 3 show a rectangular block, similar to the end of the connecting-rod, mounted on a swiveling fixture, and having a flange and a cover plate so constructed that the surfaces of the strap to be milled project clear of the fixture. Two passes at right angles with the same cutters, the head-stocks being properly adjusted, square these surfaces.

Cut No. 4 shows the same swiveling fixture is used with a central pin and different size bushings in milling the boxes. The diameter of the pin or bushing is the same as the bore of the boxes which are clamped between the collars here shown. By rotating the fixture through 90 degrees, with suitable cutters, the boxes may be milled to fit the strap at a small part of the cost of planing. The saddle being vertically adjustable in thousandths of an inch, the setting is quickly performed, and if the cutters have become worn below size, a slight vertical adjustment with two additional passes will bring the work to gauge.

Cut No. 5 shows a connecting-rod held in a pair of V-blocks, and having its ends squared; with the same pair of cutters, all four sides of both ends may be finished. This machine may also be used, to great advantage, in drilling from both sides through the strap and connecting-rod, for the through bolts, and also for shank milling the slot for the gib and key. Straddle mills are necessarily of large diameter, and for that reason expensive; the same class of work can here be done with much smaller cutters better driven. The vertical adjustment being confined to the saddle, the centers of the spindles are always in exact alignment. If with a short, rigid boring bar, having a flat cutter across its end, a hole be bored half way through a casting, and then the bar having been inserted in the other spindle, a hole bored from the opposite side of the casting, the junction of these two holes cannot be detected by the sense of feeling, so perfect is the alignment.

* * *

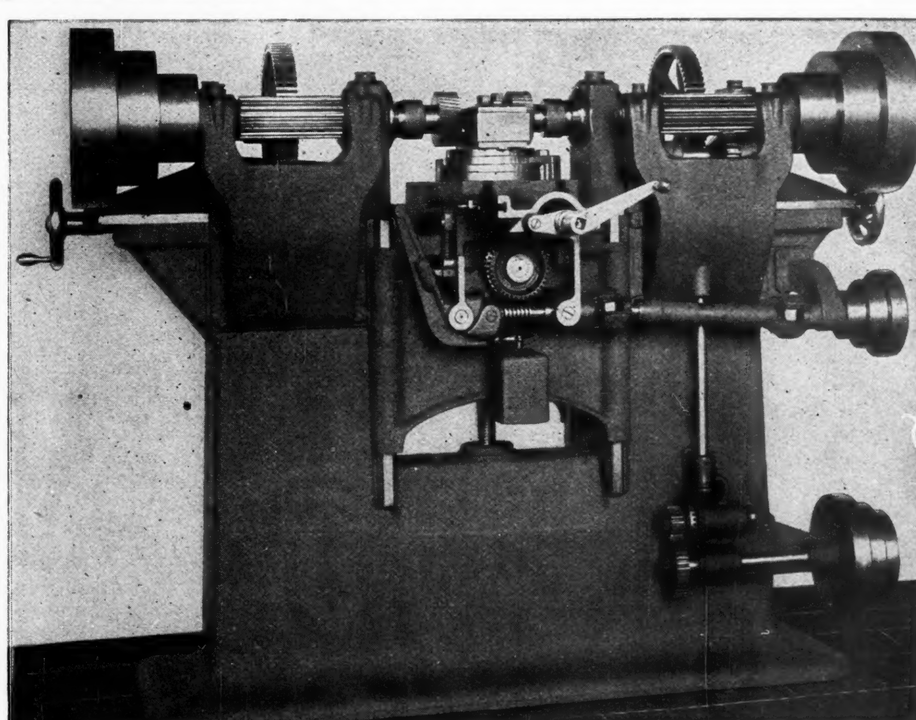


FIG. 2.—DUPLEX DOUBLE-COLUMN MILLING-MACHINE.

MASTER AND MAN.

"Missing Link."

We scarcely see a mechanical paper of late which does not contain an article upon the wage question, and we find methods,

systems and schemes as various as the objects in a mammoth museum, expounded to overcome the disagreements of "master and man" upon the price to be paid the *man* for his labor.

Before I go any farther let me say that I am no eminent authority on the subject, but simply a mechanic who uses his muscle, skill and scant store of knowledge every day of his life to make a living for himself and family; and as I have read no expressions from "this side of the fence," I offer my ideas on their merits.

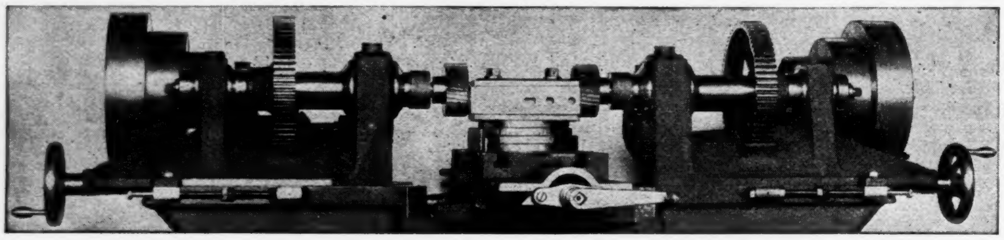


FIG. 3.—DUPLEX DOUBLE-COLUMN MILLING-MACHINE.

In the first place I consider all these new schemes and propositions worthless as far as the advantage to the workingman is concerned, although they frequently pay the manufacturer well.

Do you ask, why ?

Did you ever know of an average mechanic—no matter how hard or under what system he worked—getting much more than average wages for any considerable length of time? As "Been There" reminds us in his article, "The Boss and the Man who Worked by the Piece," in the June edition, the ignorance of the "boss" sometimes gives a man a "soft snap" and good wages for awhile; but just so sure as his wages exceed the average day rate to any very perceptible extent, just so sure will the piece price be lowered.

As an illustration I have a blacksmith acquaintance who took a contract job on a certain piece of repair work, and hired his own helper. To begin with he received 25 cents per piece and made excellent wages for himself and helper, without any extra exertion. At the end of three years he was making the same article at 2½ cents per piece, working like a slave to get out 100 pieces per day, making $1.50 for himself and $1.00 for his helper.

I am acquainted with several cases, equal to this, and believe it is a fair illustration of the effect which piece-work has on the mechanic. Nor does this system often benefit the manufacturer to such an extent as some might at first suppose, for as soon as one manufacturer adopts this system his competitors must do the same thing in order to meet his prices, and then competition begins to reduce the price of the finished product and continues to reduce it until it is down to "rock bottom," or what capitalists consider rock bottom, which is a profit quite often enormous compared with legitimate interest on money invested.

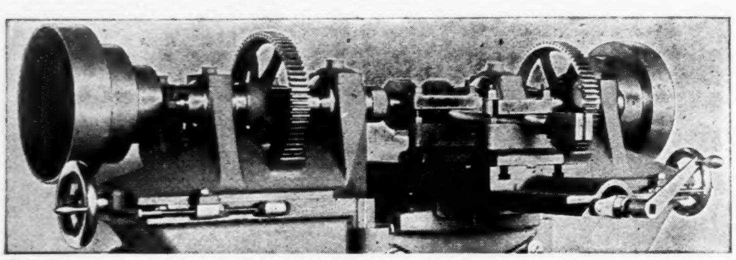


FIG. 5.—DUPLEX DOUBLE-COLUMN MILLING-MACHINE.

So the consumers are really the ones who benefit most by it.

But you say there is the co-operative contract system, and the premium plan! But what are these but the piece-work system in disguise.

All manufacturers in the same line must compete in prices, and unless one method produces work as cheap as the others, that is, unless one method gets as much work out of the men for a given amount of money as the others, the manufacturer will not tolerate it any longer than the time necessary to ascertain its relative merits.

"Been There" advocates the premium plan! I see no advantage in this over the ordinary piece-work system. For what is to hinder the employer from reducing the price on the amount which he has established as a day's work, which would also reduce the premium on the work over and above the regulation day's work in the same proportion, or demand a greater number of pieces per day, which would reduce the amount to pay premium on; or, what is the same thing to the employer, making the men work harder to make the same wages. To me everything outside of day work is piece-work, no matter what the variations may be as to the manner in which it is administered.

Obviously the average employee is at a disadvantage. He must take what he can get or quit work, and if he quits he generally "jumps from the frying-pan into the fire," for in changing situations he has his reputation as a workman to establish anew, or his new line of work to become accustomed to before he can draw the same pay as formerly.

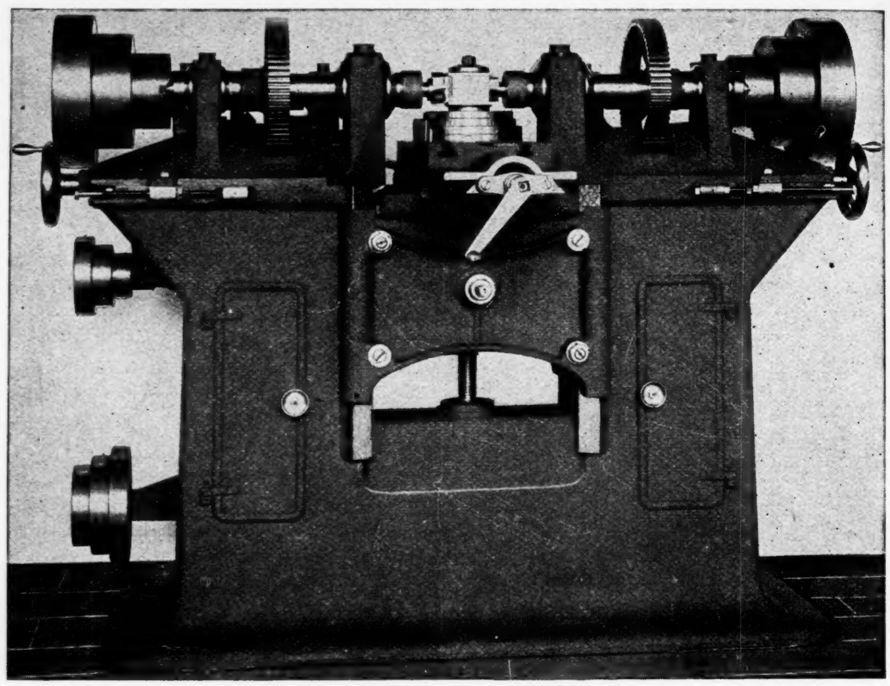


FIG. 4.—DUPLEX DOUBLE COLUMN MILLING-MACHINE.

Now where is the remedy or remedies? I believe there are two. One is possible, practical and profitable. The other may never be possible, and if possible I doubt its practicability. Let us consider the former, which we will call the "individual emancipation plan," which is open to all who possess ambition and perseverance, and is to raise one's self above the average and become a mechanic who is sought and not seeking, which we may do by devoting our leisure moments to the perusal of mechanical literature, by which we soon cultivate a taste for knowledge and advancement, which merges into a keen pleasure as we take an interest in analyzing mechanical problems and studying the construction of various mechanical devices.

Though we may never reach the top of the ladder—in fact we cannot, for the ladder seems to lengthen with the square of the distance it is ascended—we may feel assured that sooner or later we will be rewarded for each step according to its value.

My second prescription, which we will call the universal emancipation plan, which would especially benefit those who have *not* ambition or perseverance, and be of little if any benefit to those who have, would be to gather every working man (mechanic or

not) in the United States, Canada and Mexico, into an immense labor organization under one head, and let a committee from each and every class of labor establish a scale for the class which they represent. Then after all had been passed upon and recorded as law by the officials of the union, require every employer of labor —farmers and all—to sign the scale or do the work themselves. And all those who refused to sign the union should, by special act of Congress ordered by the union, be exiled to, well, say China, until the time shall arrive when they are willing to become members of said organization. This is, I believe, the ultimatum for which organized labor is striving.

Imagine this possible or actually established, then every one would realize to the fullest extent that "In union there is strength," and I imagine a most tyrannical strength.

What would the President of the United States and the lesser Government officials be compared to the president and officials of this organization? Simply tools in the hands of labor leaders. Oh! Yes! And where would the capitalists and employers be? Probably they would seek pleasures abroad until the laborers here began to get hungry and had revised the various wage scales to suit them. Then perhaps they would be kind enough to return and relieve suffering humanity by paying wages 10 or 20 per cent. lower than all previous records.

But, discarding the joker, there is one thing about a universal wage scale, providing it *could* be established and maintained, which would not be a drawback, if not an actual advantage, to the manufacturer, that is, it would place all employers upon an equal footing as far as labor expense is concerned. Each one would know that his neighbor or his competitor across the continent was paying the same for labor as himself. Then the contention would be for a location favorable for cheap fuel, raw material, water supply, shipping facilities, etc., etc., and "cheap labor market" would be out of it, and the laboring men would not be affected detrimentally by the competition of his employers.

I believe that labor unions can do little, if anything, to regulate wages. The price of labor, like that of any material article, will adjust itself according to supply and demand. And those who will can make the quality of their labor create a demand for it. The man who has the reputation of doing accurate work and an honest amount of it for a day's pay, is seldom out of employment.

On the other hand, those who think themselves as good as the best, and that there is nothing more to acquire after they have served their three or four years of apprenticeship, must resort to labor unions for sympathy and a traveling card to help them through.

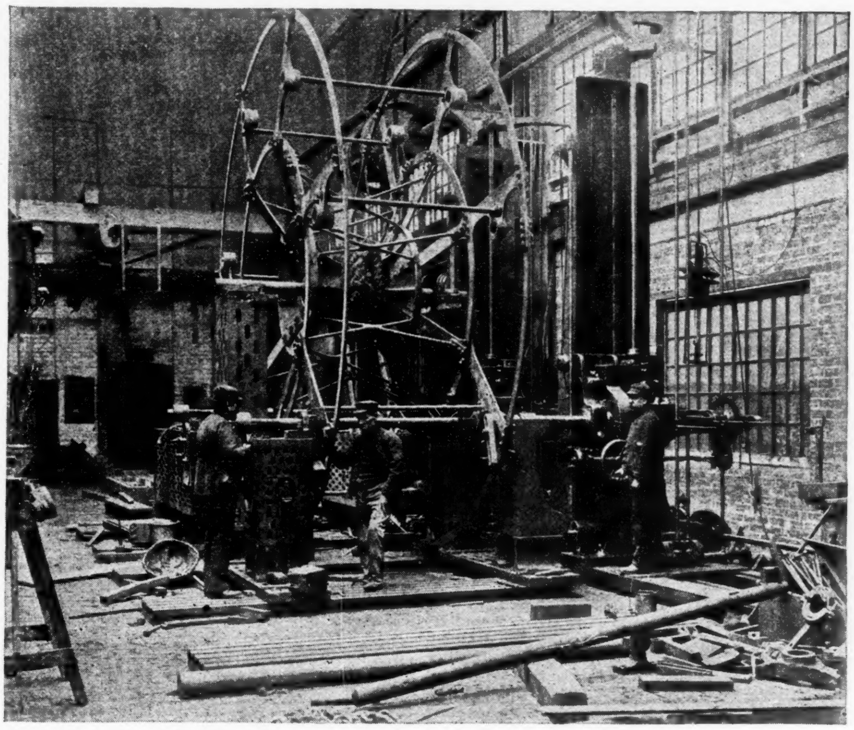
I am an antagonist to piece-work and never did any work by that system, as I consider it degrading morally and socially. Yet I have seen several places where, in a way, I should consider an employer justifiable in substituting it for the day system. Most everyone has seen a place of this kind, where lathes, planers and milling machines, and in fact everything, is running at slow speed and slow feed, while the attendants were reading, sleeping, shooting craps, etc., etc.

One extreme follows another, and piece-work is the extreme which generally follows in this case. Still, is it altogether the workingmen's fault that a shop should get into such a condition? No! If the foreman was of the right stamp nothing of the sort could occur, and then again it is the proprietor's fault for keeping a foreman or superintendent who would tolerate such as that. I believe it would be the better plan for the proprietor, when he finds his shop or manufactory in such a plight, to renovate the management before going to extremes.

If we each do what we can individually to acquire skill and knowledge in our line of work, and assist, as we can, those who seek knowledge, although we may never achieve any *great* end, we can console ourselves with the knowledge that we have done the best we can under the existing circumstances, which is a consolation not derived from joining hands with the element who carry the traveling cards.

Remember, that while "In union there is strength," "in knowledge there is power."

* * *



UNIVERSAL DRILLING MACHINE—CLYDEBANK ENGINEERING WORKS.

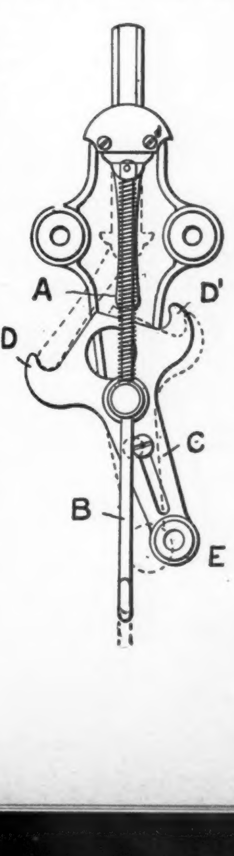
FOREIGN NOTES OF REAL INTEREST.

A LARGE DRILLING MACHINE.

The Universal Boring, Drilling and Tapping Machine shown herewith is reproduced from *Engineering*, London, and is in the Clydebank Shipbuilding and Engineering Works at Clydebank, Scotland. The machines shown were built by Messrs. Thomas Shanks & Co., and are among the largest in the works, being really portions of one machine, not unlike the "drill press of the future" described by Mr. Grant in our first article. These can operate on any vertical surface forty feet long by ten and one-half feet high; a very large range. Level iron beds, on which the work is fastened, are provided as shown. These machines have spindles 5 inches in diameter, with 42-inch travel, and bore cylinders up to 48 inches in diameter; drilling, tapping and studding their flanges at a single setting. One spindle is fitted with an interchangeable wheel arrangement for cutting inside screws, with a chaser held in end of spindle.

A NOVEL BELT SHIFTER.

Quite a novel belt shifter, made by Messrs. Armanrie & Co., Hutton Garden, London, is shown by *Industries and Iron*,, and though only adapted for a single belt, has many good points for places where this is all that is needed, as on speed lathes, emery grinders, etc. The tongue or striker A hangs normally in a vertical position, and on being pulled down by the rod B strikes the inclined surface at the right of D and forces the arm C toward the left or to position shown by dotted lines, the belt fingers being attached at E and shifting the belt. On releasing rod B the spring carries it up with the tongue, and the other inclined surface is now beneath the tongue, so that the next pull throws the lever C and shifts the belt in the opposite direction. This prevents any mistake being made in shifting, as a pull of the rod B always means a shifting of the belt either on or off, as if it is "on," it is known another pull will throw it "off."



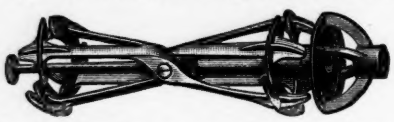
BUSINESS.

ANYONE well equipped to manufacture fare registers for street cars and similar work will confer a favor by addressing this office.

ONE correspondent has a glove fastener which he wishes made in large quantities. They are of sheet brass and must be made with precision. Another is looking for a machine for making hat-blocks. Makers of these articles should address this office.

* * *

THE WILSON FLUE CLEANER made by Genor Brothers, 99 Washington street, Buffalo, N. Y., is simple, practical and durable. No springs; being made of the best of malleable iron, it requires none, the native flexibility of the iron renders their use unnecessary. No rivets; the scrapers are each cast in one piece and no rivets are required, as they really weaken it and cause the points of the scrapers to break. It is the only cleaner with a button to protect the ends. The follower removes the loose refuse and thoroughly scrapes the tubes. Blowing steam through the tubes after using this cleaner is a waste of time.



It is easily adjusted: a few turns of the handle or follower quickly brings it to the right size.—ADV.

* * *

MANUFACTURING NOTES.

THE STAR FOUNDRY & MACHINE CO., of La Fayette, Ind., is a newly organized stock company composed of Messrs. Kreiter, Graves and Southworth, who will do a general machine shop business as well as manufacture a few specialties. They are now erecting their buildings and have placed their order with the Lodge & Davis Machine Tool Co., of Cincinnati, O., for the entire equipment of the plant. They have also bought a boiler and engine of the Lane & Bodley Co., of Cincinnati.

PARKE BROS. & CO , Ltd., of Pittsburg, Pa., have established their Connecticut agency with the Dwight Slate Machine Co., of Hartford.

THE GARRY IRON & STEEL ROOFING CO. have just received a contract from the United Salt Co. for another iron building.

* * *

FRESH FROM THE PRESS.

THE ANSONIA BRASS & COPPER CO., 19 Cliff street, New York, have issued a new catalog devoted to the merits of Tobin bronze. It gives tests of this metal in various forms, tells some of its various uses, gives weights of plates per square foot and of rods per lineal foot, and taken altogether is a useful little book for those who have use for a metal of this kind.

THE HOGAN BOILER CO., Middletown, N. Y., whose "Proofs" was noticed last month, are again in the field with another pamphlet, "Truths," which throws additional light on the disputed question of proper selection of boilers. All who are interested will want the latest information on the subject, and it will be sent on application to the above address.

THE CLEVELAND MACHINE SCREW CO., Cleveland, O., send us an illustrated catalog of their automatic machinery, "for turning and finishing metal work of every description." It describes the machines, shows the special features of each and tells what they can do. Steel balls, now so extensively used in many classes of machinery, also receive attention, their claim being that they are the largest manufacturers of steel balls in existence.

AN IDEAL ENGINE ROOM is the title of a neat little booklet issued by the Harrisburg Foundry and Machine Works, Harrisburg, Pa., and consists principally of extracts from the Boston POST, JOURNAL and HERALD concerning the new engine room of Keith's New Theater. These are rather strikingly arranged and will be interesting to engineers generally. The last half of the booklet shows various forms of Ide and Ideal engines, both singly and with direct connected generators of different makes, the illustrations being some of the finest half-tone work that we have seen.

COMPRESSED AIR AND THE CLAYTON AIR COMPRESSORS, as complete catalog No. 8, of the Clayton Air Compressor Works, Havemeyer Building, New York City, is called, contains over 80 pages, mostly devoted to the subject named. The construction of these compressors is shown, details of valves and cylinders, which will be valuable to students in this field of engineering. There is also much information concerning compressed air, such as "Loss of Pressure due to Friction," "Capacity Lost by Air Compressor Working at Different Heights above Sea Level," and other data of value to engineers and mechanics generally. The directions for erecting and operating air compressors will also be very useful to many.

WE have received sample pages from "Engineering Contracts and Specifications" including a Synopsis of the Law of Contracts, by J. B. Johnson, C. E. These are taken at random from a 420 page book, and "judging by the sample," as the old lady said about half a chicken she had eaten, "we'd like some more." It will be found valuable to contractors, and will be sent post-paid on receipt of $4.00 sent to the Engineering News Publishing Co., Tribune Building, New York City.

THE HILLES & JONES CO., Wilmington, send us Catalog K, whose cover combines black, red and yellow on a white ground, with startling effect. It is sure to attract attention, and that is its main object, but—. It contains many illustrations of various heavy punching and shearing machines made by them, and will interest those who have use for such tools.

THE report of the Canal Commission of Philadelphia, in regard to the Atlantic Coastwise Canal across New Jersey, is at hand and shows a careful study of the question by the Commission. The consulting engineer, Mr. N. H. Hutton, estimates a cost of $24,124,700 for a canal 28 feet deep, and $14,374,000 for one 20 feet deep, the additional advantages seeming to favor the deeper channel. Prof. L. M. Haupt, the engineer in charge of survey, has long been an active worker in behalf of this canal, and it must be very gratifying to him to see his work taking definite shape.

SPON'S ENGINEERS' AND CONTRACTORS' ILLUSTRATED BOOK OF PRICES, 1895-1896. 300 pages, 8½ by 11 inches. Spon & Chamberlain, 12 Cortland street, New York. Price $3.00. This is a collection of price lists, embracing about all the materials that an engineer or contractor needs for his own use or for the construction of almost any plant he may undertake. The best firms in England are represented in its pages, and it gives an excellent idea of English practice and design in many branches of engineering. Messrs. Chas. Churchill & Co., Ltd., are also to be found with an extensive list of American tools, among them the well known Brainard milling machine, the Boynton & Plummer and Hendey shapers, Wheeler and Hendey planers, Cushman, Horton and Wescott chucks, Flathers, Reed, Barnes and Jones & Lamson lathes, and Prentice Bros. drills. Those whose interest in mechanical subjects extends across the water (and what true mechanic is not so interested) will find much of value in designs and in machinery used.

THE LANE & BODLEY CO., Cincinnati, O., have issued a neat catalog devoted to the Columbian Corliss engine built by them. Beginning with a table of standard sizes of engines from a 10 by 24 to a 32 by 60, giving power with various pressures and cut-off, space occupied, etc.; details of their method of construction are shown and are of interest to designers and mechanics generally. The square corners usually seen on the Corliss cylinders are missing on their engines and they are neatly rounded over the valves. Solid end rods are used, bored guides and other features which are now considered as constituting good practice. They also show an engine with two eccentrics for controlling cut-off from 0 to ¾ stroke, for the heavy duty now required in street railway plants, rolling mills, etc. Twenty of the 74 pages contain useful data which will be appreciated by the engineer.

MESSRS. J. T. SLOCOMB & CO., of 229 Eddy street, Providence, R. I., have issued a new catalog of the machinists' tools made by them. These include their standard Inside Micrometer Caliper, Inside Micrometer Gauge, Combination Micrometer Gauge (which also makes a very handy depth gauge) made in three different styles. Their Center Indicator is well known by machinists and is a very useful tool in any kit. The combination center drills, which drill and countersink a center at the same time, has made many friends in the shops, and is considered indispensable by many. They are now making outside micrometer calipers to measure from 1 inch to 6 inches, each having a movement of one inch. The standard Revolution Counter is also shown, and besides these the catalog contains much information for mechanics generally.

WE are favored by Mr. Henry C. Adams, statistician of the Interstate Commerce Commission, with a copy of Bulletin No. 1, "Decisions upon Questions raised under the Classification of Operating Expenses," and also one of the classifications to which it refers. These are very interesting to those who are engaged in this department of railway operations, and will be preserved as a reference where similar cases occur, as they are likely to do.

THE DWIGHT SLATE MACHINE CO., 15 Central Row, Hartford, Conn., issue a 124 page catalog devoted to their manufactures, which are well known in the lines of light or special machinery. The Slate sensitive drills, with spindles varying in number from one to four. Other types of drills, however, are made with any number of spindles desired, each adjustable, one of those shown having nine spindles. A five-spindle revolving drill-head which is shown is particularly attractive for its ingenuity. Special marking machinery, pinion and gear cutters, both partially and fully automatic, rack cutters and center grinders, drill grinder and grinding machines, which are capable of a large variety of work; tool grinders, milling machines, screw slotters and other special tools too numerous to mention, but of interest to mechanics generally. Few superintendents or foremen can look this through without seeing several tools they need and would like to add to their equipment.

EARLE C. BACON, Havemeyer Building, N. Y., the well-known engineer and builder of hoisting, crushing and mining machinery, has just issued a very complete and fully illustrated catalog of The Farrel & Bacon Ore and Rock Crushing Machinery, as built at the Farrel Foundry & Machine Co.'s Works, Ansonia, Conn., and can be had on application by those interested. It is one of the most complete catalogs of the kind ever issued, and very interesting, and should be in the hands of all those who use, or intend doing so, this class of machinery. He is also preparing for publication a catalog of hoisting and mining machinery, which will be issued next month. All are completely illustrated with half-tone prints.

MESSRS W. D. FORBES & CO., 1300 Hudson street, Hoboken, N. J., send us their latest catalog, which is neatly printed and well worth a careful perusal. The introduction contains such good advice and is so pertinent that we shall reproduce it in the near future, and advise others to note its contents, as many of the points mentioned will be of value to those ordering work done. Their compound and triple expansion yacht engine is shown, also their high speed automatic governed engine, and they will be pleased to answer any communications regarding either. Their milling machine, which was shown in our May issue, is now put on the market for the first time, and has many good features, one of them being great rigidity. Revolution counters, hydraulic hand pumps, and National chucks complete the catalog, which contains in addition two valuable tables for machinists and engineers, copies of which are said to be sent, nicely mounted on cardboard, for the asking.

THE REPAIR AND MAINTENANCE OF MACHINERY. Thomas W. Barber, M. E., London, E. & F. N. Spon; New York, Spon & Chamberlain, 12 Cortlandt street. $3.50. This is a well bound book of about 470 pages and 400 illustrations, which we regret to say are not in keeping with the rest of the book, many of them being crude and evidently made from free-hand sketches. The information given is, however, of value to any engineer or mechanic who has repairs to make or who wishes to be posted on the construction of the various machinery described, and to be on the lookout for defects most likely to occur. Among the many subjects treated are Air Compressors, Boilers, Blowing Engines, Condensers, Corliss Valve Gear, Cranes, Gas, Oil and Steam Engines, Foundry Work, Locomotives, Machinery and Wood Working Machines. Gas and Oil engines are particularly well treated, and this portion will afford much information to its readers. Many good points are to be found concerning repairs of various kinds, tools to be used, etc., and the numerous tables include speed of machine tools, weight and dimensions of various pipes, friction of water in pipes, dimension of hydraulic presses, horse power of driving ropes, and others equally valuable. The reference to injectors for locomotive use is not in keeping with American practice, as it intimates that they cannot be entirely depended upon, pumps being given the preference. It can be heartily recommended, however, to any one in need of information on these subjects.

THE elegant North Shore Limited of the New York Central, daily, for Detroit and Chicago.